CANADIAN MUNITIONS NUMBER—JANUARY, 1941

MACHINERY

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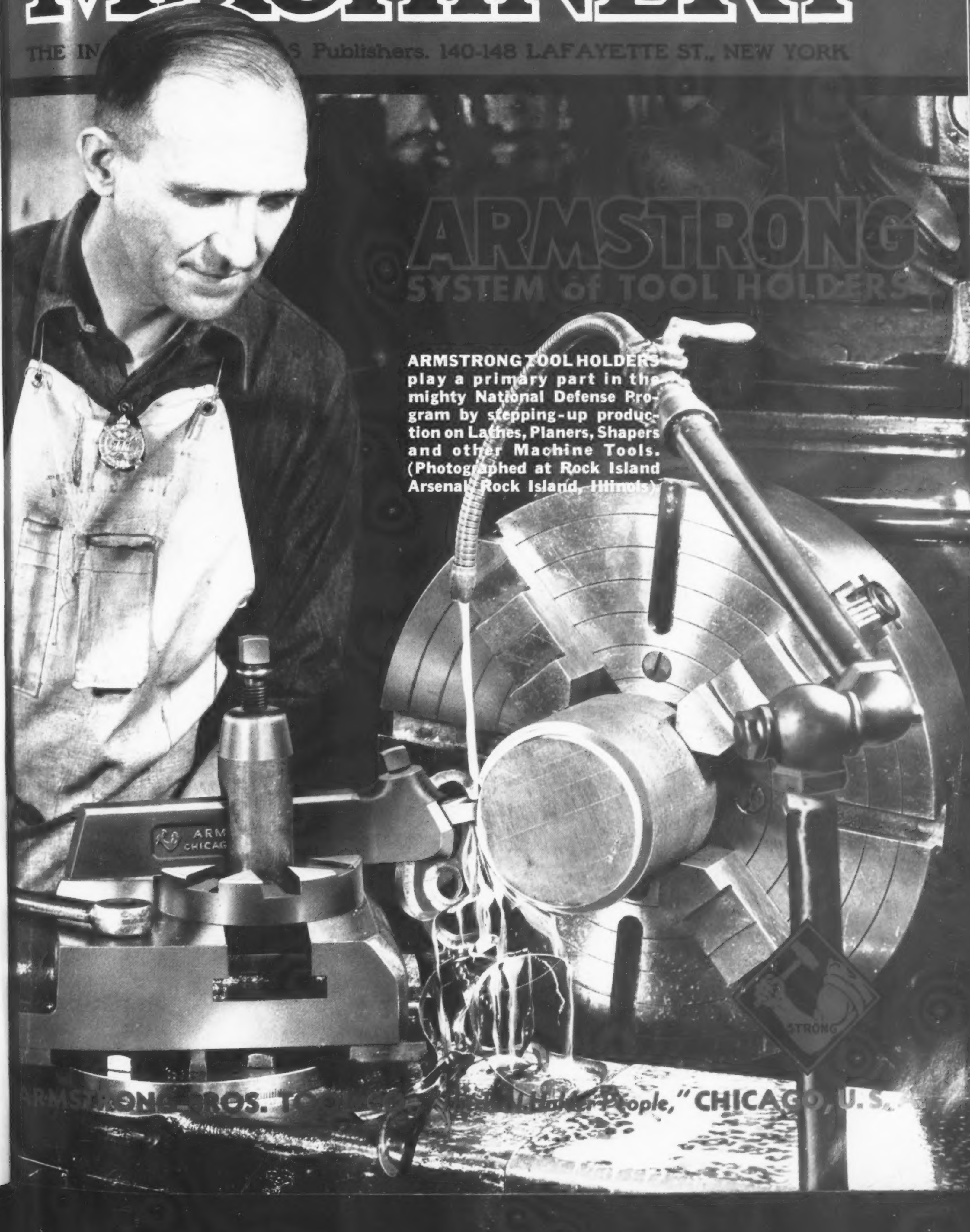

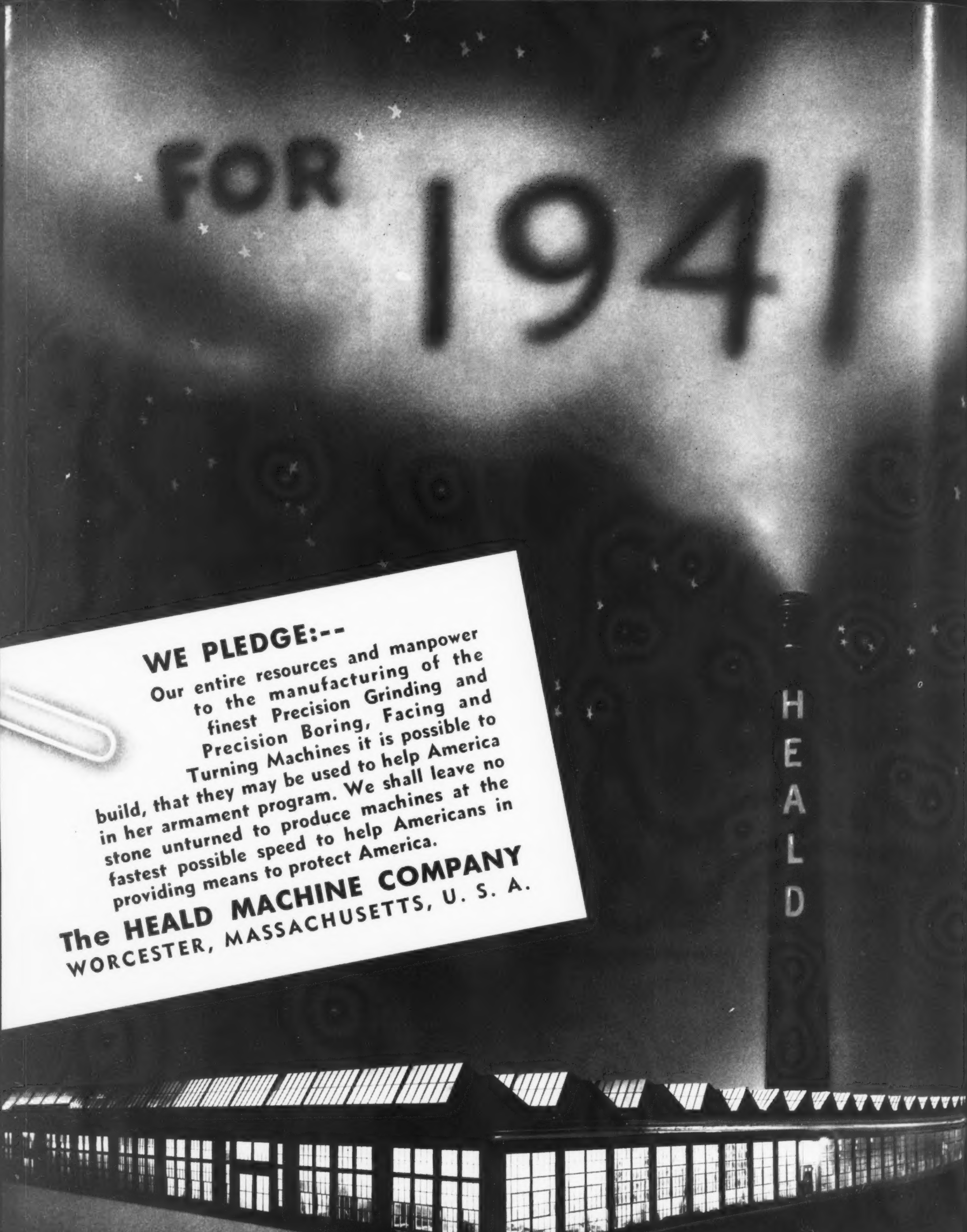

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MACHINERY

That the machine tool is the basis on which the Armament Program rests is now fully appreciated. But practically every activity of our modern life depends just as much on machine tools, even our recreation and entertainment. "The Machine Shop Behind the Scenes in a Motion Picture Studio" is the feature article in February MACHINERY. It emphasizes the fine workmanship and precision mechanical equipment required in keeping a motion picture studio going.

Volume 47
Number 5

JANUARY, 1941

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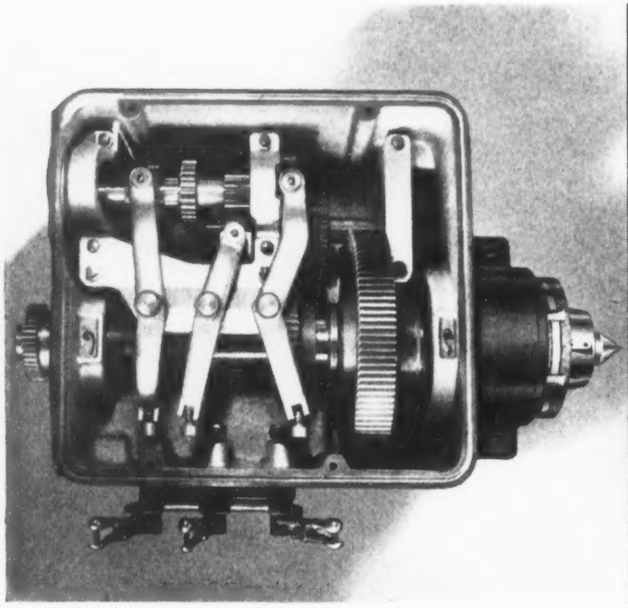

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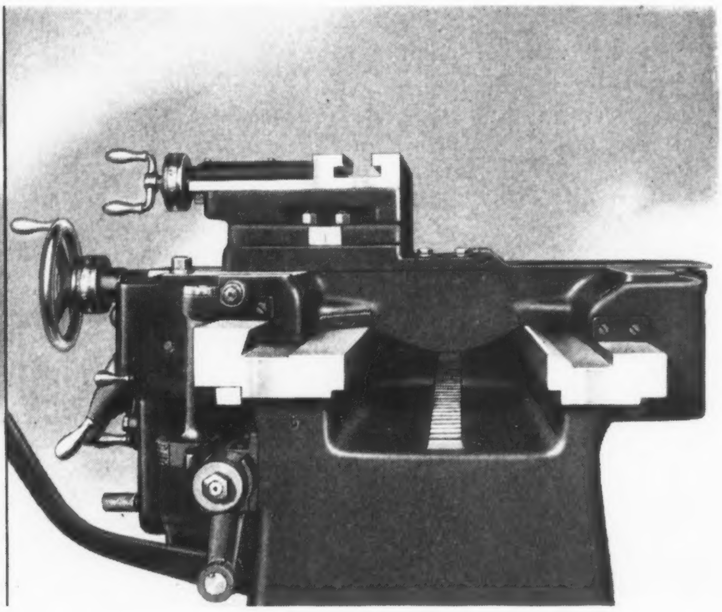

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THE WORLD OVER · KNOWN · LATHES · GOOD LATHES ONLY · L&S LATHES

The LODGE & SHIPLEY

Canada's Munition-Making Methods

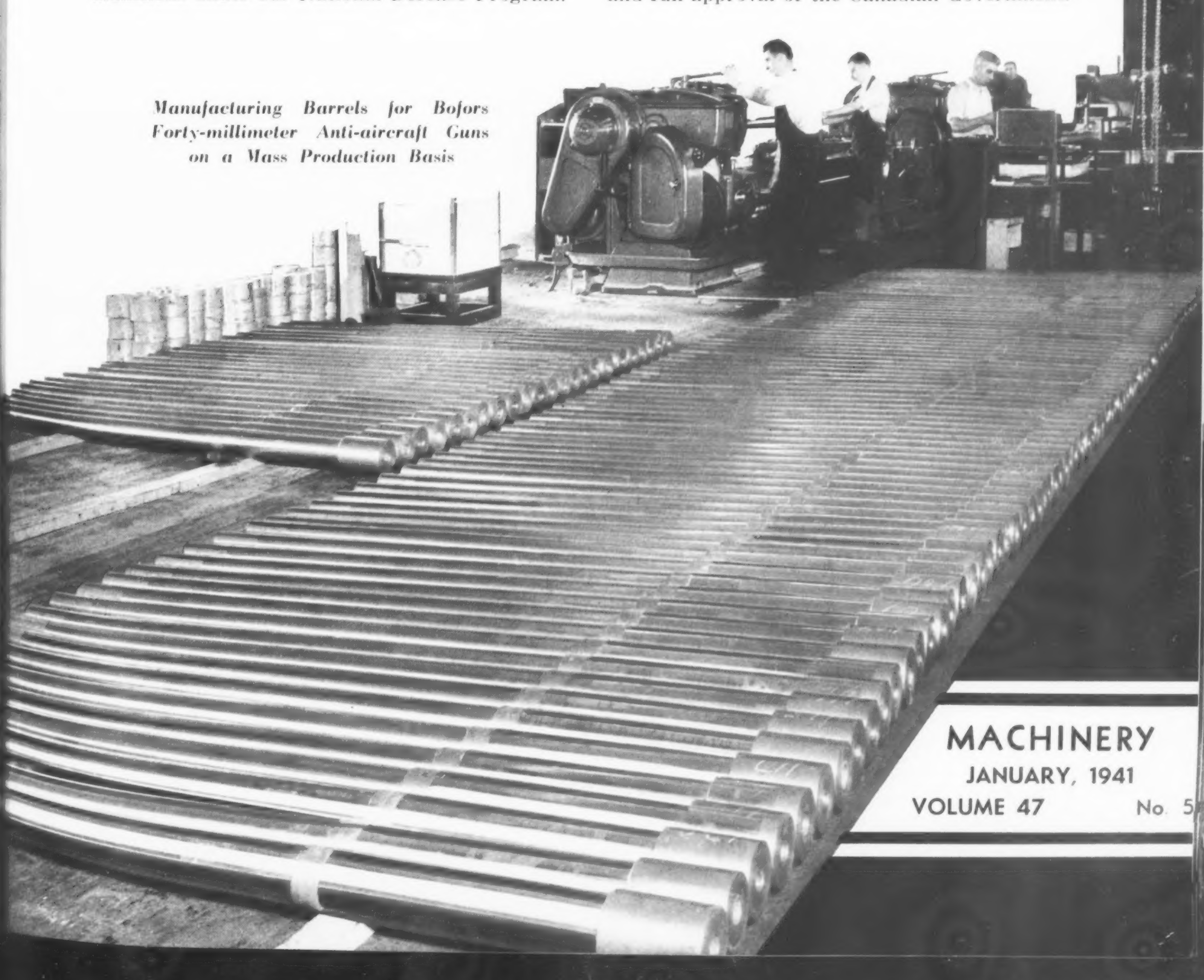
HOW CANADA MAKES MUNITIONS

POINT THE WAY

INDUSTRIAL Canada has been engaged for more than a year in producing munitions and other war-time supplies to meet the needs of Britain's Armies. Canadian manufacturers have therefore already solved production problems that now confront American concerns starting to make munitions under our National Defense Program.

For this reason, MACHINERY presents, in this number, a series of articles describing in considerable detail methods used in the shops of our northern neighbor in manufacturing shells, cartridge cases, guns, fuses, and mechanical transports. These articles are being published with the cooperation and full approval of the Canadian Government.

Manufacturing Barrels for Bofors Forty-millimeter Anti-aircraft Guns on a Mass Production Basis



MACHINERY
JANUARY, 1941
VOLUME 47 No. 5

Canada BRITAIN'S WESTERN

MUNITIONS in quantities that challenge the imagination are required for warfare as it is waged today. During the terrific aerial bombardment which English cities have withstood with a fortitude that has won world-wide admiration, the anti-aircraft defense guns have fired many millions of shells. The supplying of shells to meet such a demand alone is a task of immense proportions, but, in addition, it is necessary to maintain a continuous flow of gun barrels and barrel liners for replacement purposes on the anti-aircraft guns.

These requirements are for defense only. But wars are not won by defense alone, no matter how brilliant it is. If Great Britain is to conduct a successful offensive against the enemy, airplanes, rifles, machine guns, tanks, transportation equipment, torpedo boats, etc., will be required in great quantities. As never before in the history of mankind, therefore, the responsibility for victory rests to a large degree upon the skilled workmen and the machine shops "behind the lines" who alone can furnish the highly mechanized implements of modern warfare.

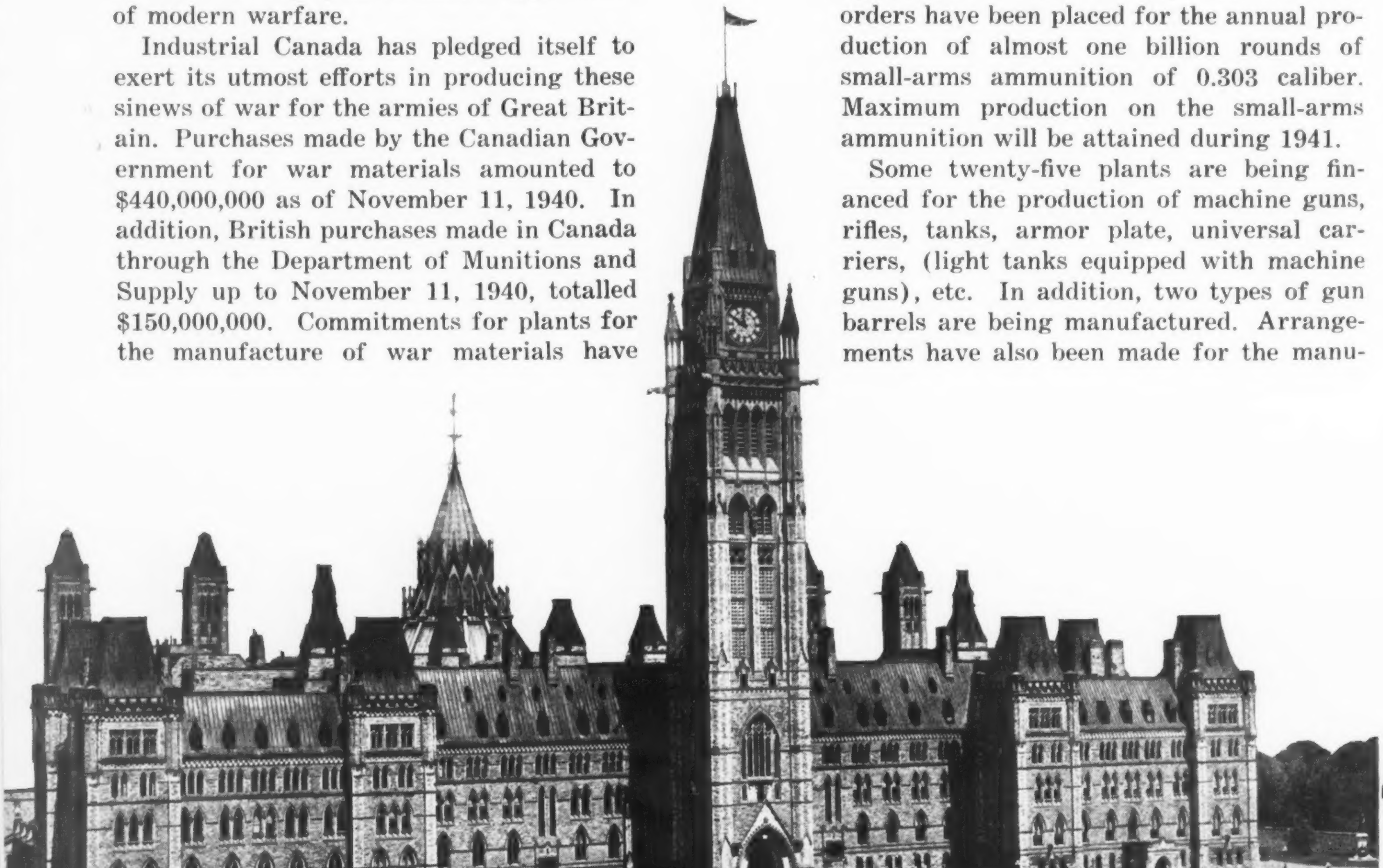
Industrial Canada has pledged itself to exert its utmost efforts in producing these sinews of war for the armies of Great Britain. Purchases made by the Canadian Government for war materials amounted to \$440,000,000 as of November 11, 1940. In addition, British purchases made in Canada through the Department of Munitions and Supply up to November 11, 1940, totalled \$150,000,000. Commitments for plants for the manufacture of war materials have reached a total of about \$250,000,000, of which about two-thirds of the cost is being borne by Great Britain and one-third by the Dominion of Canada.

All expenditures and commitments for munitions for the Canadian Government and for the United Kingdom in Canada are made through the Department of Munitions and Supply. Up to mid-November the total expenditures and commitments amounted to approximately \$840,000,000.

When one considers that the population of the Dominion is less than 12,000,000 persons, the manufacturing program under way represents a commendable achievement. The expenditures made by Canada toward winning this war already exceed the total of the 1914-18 conflict.

More than seventy industrial plants in Canada are now engaged in the manufacture of shells, cartridge cases, fuses, primers, and other items required to make a complete round of ammunition ready for filling with explosives. Ammunition of ten different calibers is being produced for the larger guns at an output estimated at more than 13,000,000 rounds annually. In addition, orders have been placed for the annual production of almost one billion rounds of small-arms ammunition of 0.303 caliber. Maximum production on the small-arms ammunition will be attained during 1941.

Some twenty-five plants are being financed for the production of machine guns, rifles, tanks, armor plate, universal carriers, (light tanks equipped with machine guns), etc. In addition, two types of gun barrels are being manufactured. Arrangements have also been made for the manu-



By THE HONORABLE C. D. HOWE
Canadian Minister of Munitions
and Supply

ARSENAL

facture of guns and gun carriages in Canada, both on Canadian and British account, of the following types: 40-millimeter Bofors anti-aircraft guns; 3.7-inch anti-aircraft guns; 25-pounder guns and carriages; Colt-Browning aircraft machine guns; Colt-Browning tank machine guns; 6-pounder guns for tanks; 2-pounder anti-tank guns and carriages; 4-inch guns and mountings; 12-pounder guns and mountings; 4-inch naval guns; 6-inch naval guns; Lee-Enfield rifles.

Further arrangements have been made for additional types of naval guns and mountings. The result is that Canada will shortly be making practically every type of gun in use in the present war. Automotive plants are turning out thousands of motor transport vehicles and universal carriers.

Engines for airplanes are being purchased either from the United States or from the United Kingdom, but more than $3,000,000 has been expended in making plant expansions in the airplane building industry, and two additional plants for the production and overhaul of aircraft are under construction at an estimated cost of $2,500,000. Sixteen shipyards on the Atlantic and Pacific coasts and on the St. Lawrence River and Great Lakes have been busily engaged in the construction of many corvettes and minesweepers and in the conversion of passenger and freight vessels into armed merchantmen. Twenty-five additional shipyards are turning out high-speed motor torpedo boats, rescue vessels, target boats for bomb practice, and scores of other small craft.

Eight companies that are wholly owned by the Crown have been organized by the Department of Munitions and Supply to meet various special needs. One of these companies will manufacture the Lee-Enfield rifle; another will produce scientific instruments, especially those requiring optical glass; another administers fourteen major explosive, mechanical, and kindred projects.

Still another of these firms, known as the Citadel Merchandising Co., Ltd., places machine tool orders both for the Department of Munitions and Supply and for various private firms who have contracted to manufacture war materials. The total orders placed by this company amounted to $17,000,000 at the end of September, 1940, and these orders did not include machines bought directly by the contractors. Machine tools are the most important of all equipment required in the production of war implements, and it is most fortunate for Canadian industry that the American Government has generously allocated machine tools to Canadian plants, when the United States itself is undertaking the greatest armament program of any peacetime period.

THE HONORABLE C. D. HOWE

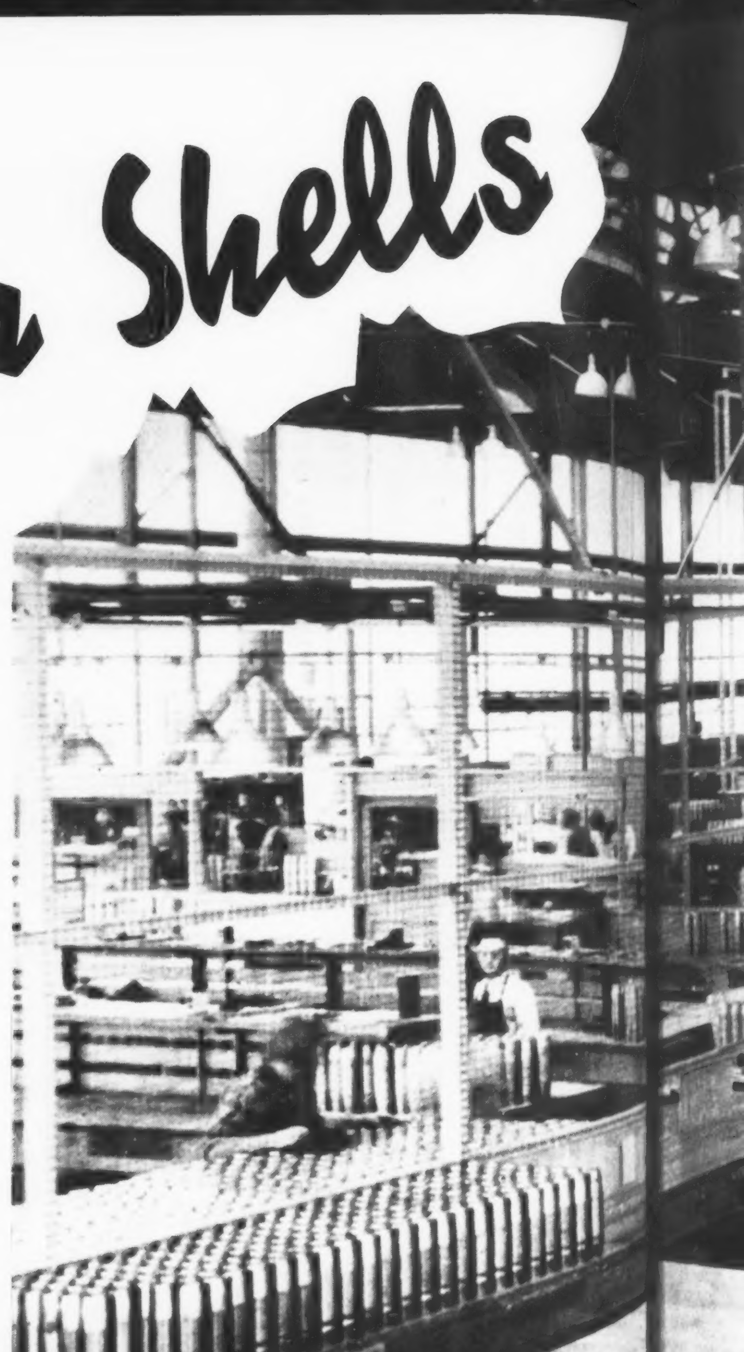
There are a number of reasons why Canada has become an important arsenal of the British Empire. First, it is relatively safe from attack by the enemy. Second, it is the most highly developed country industrially in the British Empire outside of the United Kingdom. Third, Canada is the nearest to the British Isles of any of the overseas dominions. Fourth, it adjoins the United States and has quick access to raw and manufactured products of that friendly neighbor. Fifth, Canada has the necessary raw materials, or convenient access to them, and vast electrical energy to operate its factories; in addition, it has industrial plants and workmen trained in mass production methods.

Canada chose an important role in the present conflict and intends to fill it heroically, in the shop, as well as on the battle front.

One Million Shells A Month

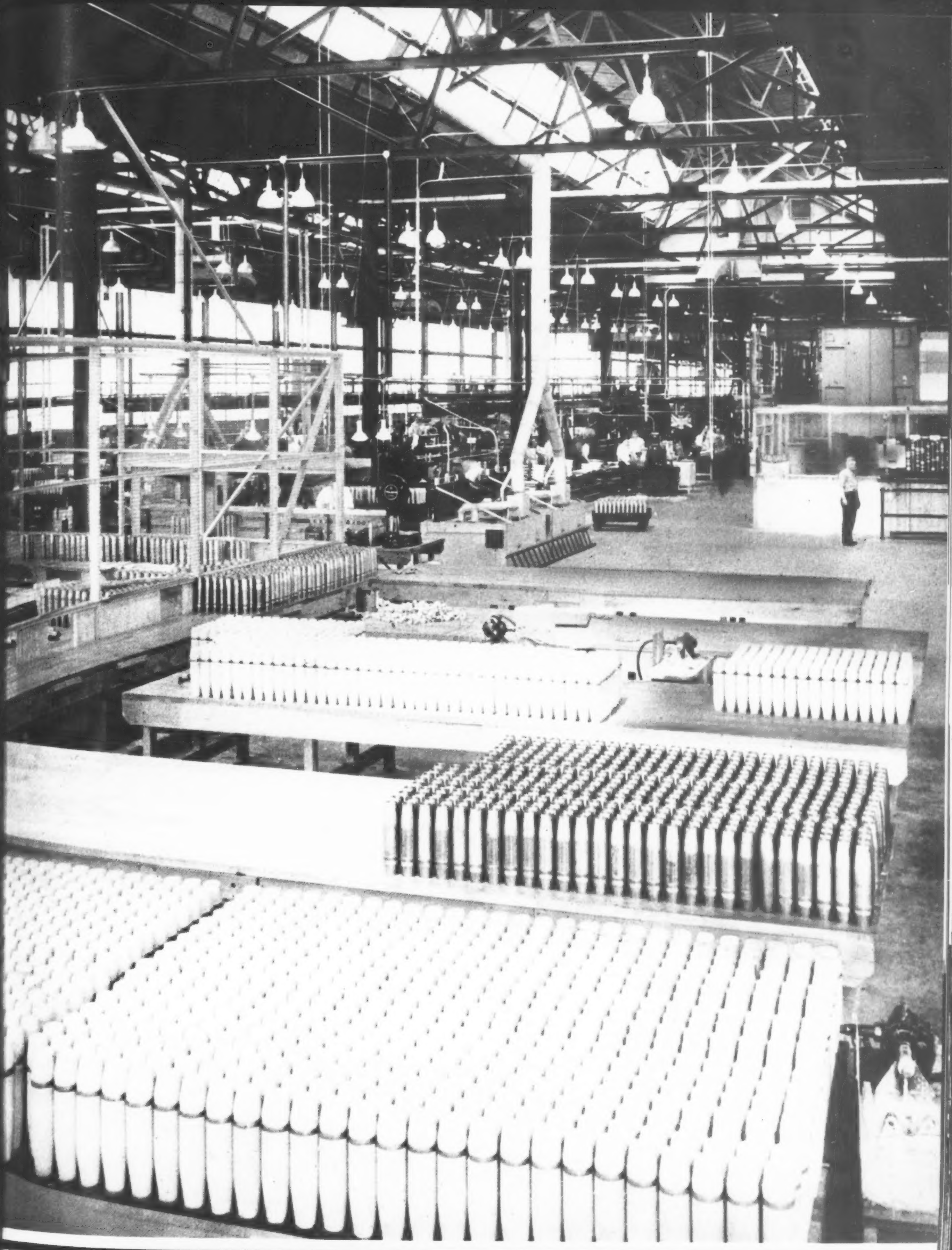
FOR BRITAIN'S ARMY

By CHARLES O. HERB



CANADIAN industry started back along familiar ground when it turned to the manufacture of shells to meet the needs of Britain's armies, as over 215,000,000 shells were produced by the metal-working plants of Canada in the first World War. This was a most remarkable record, in view of the fact that not a single artillery shell had been made in the Dominion prior to the year 1914. Whether such a high production will be required in the present war will depend upon the future trend on the battlefields of Europe. Based on present orders, Canada has already equipped itself to produce a minimum of 1,000,000 shells every month.

Numbers of manufacturing plants of considerable size are now devoted entirely to shell production, and there are others engaged in manufacturing the cartridge cases, fuses, primers, gaines, etc., necessary to complete the shells. Manufacturing methods differ vastly from those followed in the last World War as a result of the application of the latest types of machine tools and other metal-working equipment. This article will describe operations in the manufacture of 25-pounder shells (see Fig. 1) in a plant in Ontario, which also produces 3.7- and 4.5-inch shells, the total output being approximately 60,000 a week.



ONE MILLION SHELLS A MONTH

Fig. 1. Finished 25-pounder Shells and Plug that is Screwed into the Nose, as Shown in the Shell at the Right, to Keep out Moisture

The 25-pounder shells are forged from 3 1/2-inch square bars which are received from the mills in lengths of 8 feet. These bars are cut into billets 9 1/2 inches long by an Airco Radiagraph automatic oxy-acetylene cutting machine, as seen in Fig. 2. Twenty bars (constituting one ingot) are laid on the table at one time with their forward ends against a stop-plate and all of them cut through with one automatic traverse of the cutting head across the table. A preheating torch is moved by hand ahead of the torch which actually cuts through the bars. Approximately 65 billets are cut per hour by each machine.

The table on which the bars are supported is constructed of rollers on which the bars can be easily rolled forward against a stop to position them for successive operations. When the bars are received at the plant, they have identification symbols on them that indicate the mill and the heat in which the individual ingots were produced. The billets are similarly marked before they are loaded on skids for removal from the oxy-acetylene cutting-off machine.

The skids of billets are transported by an overhead crane to a Stewart rotary gas-fired furnace equipped with a revolving hearth, 20 feet in outside diameter by 28 inches wide. The billets are loaded on this hearth on end, and pass around the furnace in approximately two hours, during which they are heated to a temperature of approximately 2000 degrees F., the maximum temperature of the furnace being 2192 degrees F. Tongs are used in loading the billets on the hearth and in removing them. As the heated billets are taken from the furnace, the scale is knocked off, so as to eliminate all foreign matter in the finished shells.

The shells are immediately transferred to an ad-

Fig. 2. Cutting Billets of Square Cross-section for Shell Manufacture from Bar Stock with an Automatic Oxy-acetylene Cutting Machine

jacent vertical hydraulic press of 350 tons capacity for a piercing operation. In this operation, a hole approximately 2 1/8 inches in diameter is pierced to a depth of 7 1/4 inches, and the billet is expanded to an outside diameter of approximately 4 1/2 inches, the length remaining 9 1/2 inches.

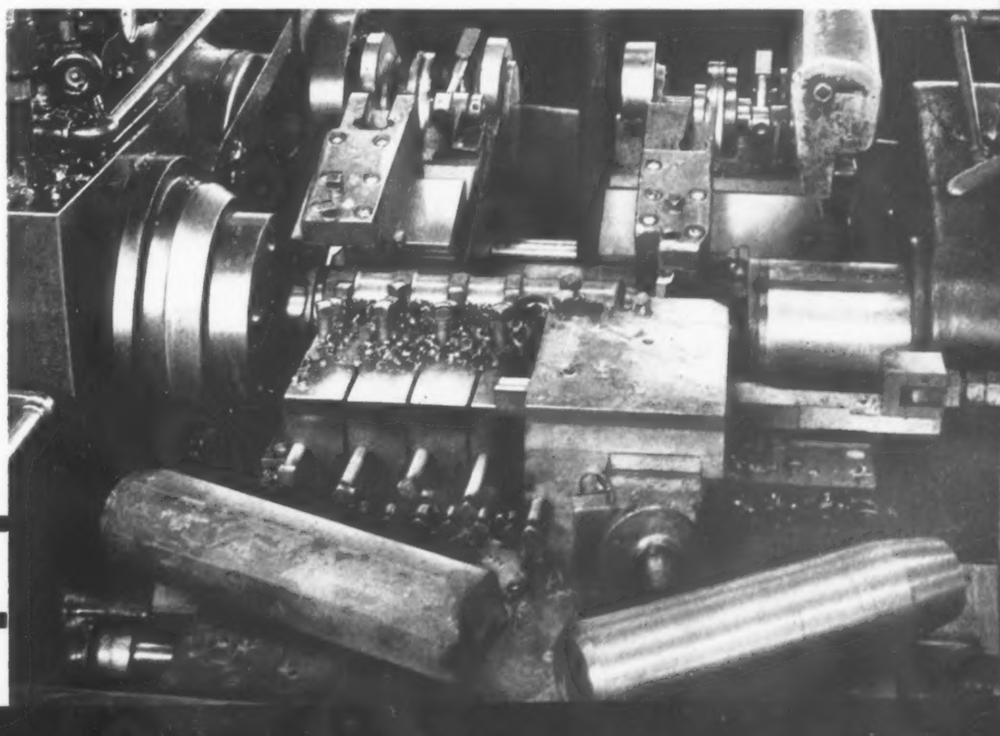
For this operation, the heated billet is placed on a circular steel block above a vertical punch, as shown in Fig. 5. When the press is operated, the ram lowers a die over the billet until it completely encloses it, and then pushes the billet down over the stationary upright punch until the hole has been pierced to the required depth. A hydraulic cylinder at the bottom of the press exerts a pressure of 60 tons on the work-holding plate through the medium of four vertical pins supported by the piston during the entire operation, so as to hold the billet central in the die while the cross-section is being transformed from square to round. When the ram ascends at the end of the operation, the hydraulic piston pushes the work-holding plate upward and strips the shell forging from the punch. The shell is stripped from the die by a knock-out device.

The application of a generous supply of cooling water to the external circumference of the die is an important factor in the success of this operation. The holder in which the die sleeve is assembled is made with a spiral groove that extends almost all the way from the top to the bottom of the holder. The groove is approximately 1/2 inch wide by 1/2 inch deep, and is machined to a lead of about 2 inches. Water at city pressure is constantly forced through this groove to keep down the temperature of the die.

With this cooling provision, between 1500 and 2000 shells can be pierced before the die wears out. The punch remains comparatively cool, because it

Fig. 3. Two Sets of Rollers Used in a Horizontal Hydraulic Press for Drawing the Shells to the Required Length and Reducing Their Diameter

Fig. 4. Rough-turning the Shell Forgings, Facing the Base End, and Cutting off the Nose End in a Lo-Swing Automatic Lathe



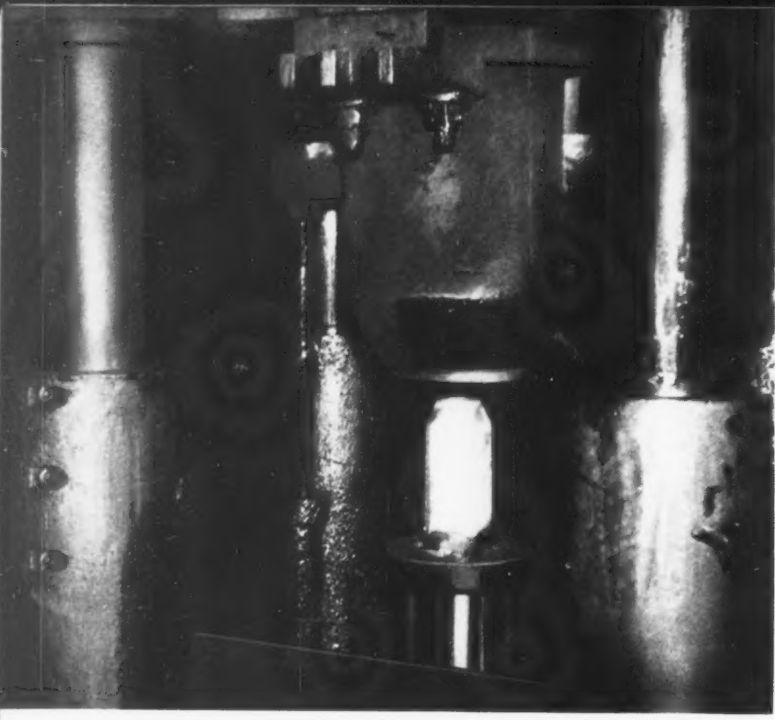


Fig. 5. The First Step in Shell Manufacture after the Billets have been Heated Consists of Piercing a Cavity in the Billet and Forging it to a Round Cross-section

is completely flooded with water at all times, except when actually piercing the cavity. In the illustration, the punch is seen in the middle of the four rods that carry the work-supporting block. The die is turned a slight amount within its holder after 700 or 800 shells have been pierced, so as to present different portions of the surface to the square corners of the heated billets. The punch is made with a shank and a removable nose-piece.

After the piercing operation, the billet is placed in front of the hydraulic ram of a Wellman type horizontal drawing press, of 80 tons capacity. The punch of this press forces the billet through five sets of rolls to reduce the diameter to about 3 3/4 inches, and at the same time, increase the length to 15 1/2 inches. The punch enters the shell cavity and extends it to a depth of 13 3/4 inches.

Each of the five sets of rolls comprises three individual rolls disposed around a circle, as illustrated in Fig. 3, which shows two sets of rolls dismantled with their housings from the drawing press. The rolls of the successive sets vary in outside diameter, gradually reducing the diameter of the shell and increasing its length. The roll housings are mounted on large-diameter bars which extend along the sides of the drawing press. The method of assembling will be apparent from Fig. 6, which shows the discharge end of the drawing press.

When the shells leave this machine, the dimensions of the inside cavity are true to size within plus or minus 0.004 inch, and the internal surface has a high degree of smoothness for a forging. This is of vital importance, as no machining operations are to be performed on this cavity. Each time the punch returns from the drawing operation, water is applied to it copiously for cooling purposes through several pipe lines. Lubricant with a graphite base is applied to the punch with a brush before it makes each forward stroke. The punch pushes each shell completely through the rolls and past two spring-actuated horizontal slides, seen in Fig. 6, which strip the shell from the returning punch.

There are a number of these horizontal presses in the plant, each of which has a production of 2250 shells per day of twenty-four hours. At the end of the drawing operation, the shells are allowed to cool while standing upright on the floor with the base end resting on coarse sand.

In finishing the external surfaces of this shell, less than 3/16 inch of stock is removed on each side, the reduction in diameter being only about 0.300 inch. The first machining operation consists of center-drilling the closed or base end of the shell. This operation is performed in special Williams lathes, the shell being slipped over a mandrel attached to the headstock spindle, which is equipped with air-operated members that are expanded radially to grip the shell securely from both ends of the cavity.

The tailstock, which carries the center drill, is

Fig. 6. The Discharge End of the Horizontal Drawing Press which is Equipped with Five Sets of Rolls of the Type Illustrated in Fig. 3

Fig. 7. Heating the Nose End of Shells in a Gas-fired Furnace Constructed with Eighteen Heating Compartments that are Arranged in Two Rows

provided with a cross-slide movement to permit quick loading and unloading without the necessity of extended lengthwise movements of the tailstock. During reloading, the tailstock is positioned at the back of its cross-slide. When a shell has been placed on the mandrel, the tailstock moves forward automatically into line with the center of the work, after which the center drill is automatically fed into the work and withdrawn when the center has been drilled to depth. The tailstock then returns to its rear position on the cross-slide. Stops are provided on this machine to determine whether the hole of each shell is closely concentric with the external surface. The centering machines are located in close proximity to the drawing press, so as to eliminate unnecessary trucking of work.

Rough-machining of the 25-pounder shells is performed in Lo-Swing lathes tooled up as shown in Fig. 4. This illustration also shows the appearance of the rough forgings as they reach this machine and of the rough-turned shells upon the completion of the operation. Six tools on the front carriage take turning cuts simultaneously, five of them along a straight path and the one at the extreme right at an angle to form the taper at the base end. A Carboloy cutter is used for the heavy taper cut, and it is fed at the desired angle through a spring action which holds the forward end of the tool-block against the contour surface of a bar type cam. This cam is held stationary by being attached to the tailstock. Each turning tool takes a cut about 2 1/2 inches long.

While the turning cuts are in progress, two tools on cam-operated tool-blocks at the rear of the machine feed forward to face the base end of the shell and to cut off the excess stock on the nose end. Each shell is loaded on a loose mandrel before it is placed in this machine, the loose mandrel contacting an arbor that extends from the headstock chuck. The chuck arbor is provided with expanding jaws that grip an inside surface of the mandrel for driving purposes.

The opposite end of the shell is supported by the tailstock center, which is moved into position by air. When the tailstock center presses against the end of the shell, the mandrel is pushed firmly endwise against the arbor of the chuck, thus forming, in effect, a mandrel that is solid with the chuck arbor. The use of loose mandrels accurately positions the work and controls the tailstock movements which are necessary for reloading. The chuck is also air-operated. Soluble oil is supplied to the tools and work in this operation at the rate of 75 gallons a minute.

From the rough-turning operation, the shells go to a Stewart gas-fired furnace of the type seen in Fig. 7, where they are heated to approximately 1832 degrees F. for a length of about 4 inches from the open end preparatory to a bottlenecking operation. The furnace has eighteen compartments for heating eighteen shells at one time, each shell remaining in the furnace about twelve minutes.

Fig. 8. Producing the Bottleneck on the Nose End of a Heated Shell in a Hydraulic Press. The Shell has been Rough-turned in a Previous Operation

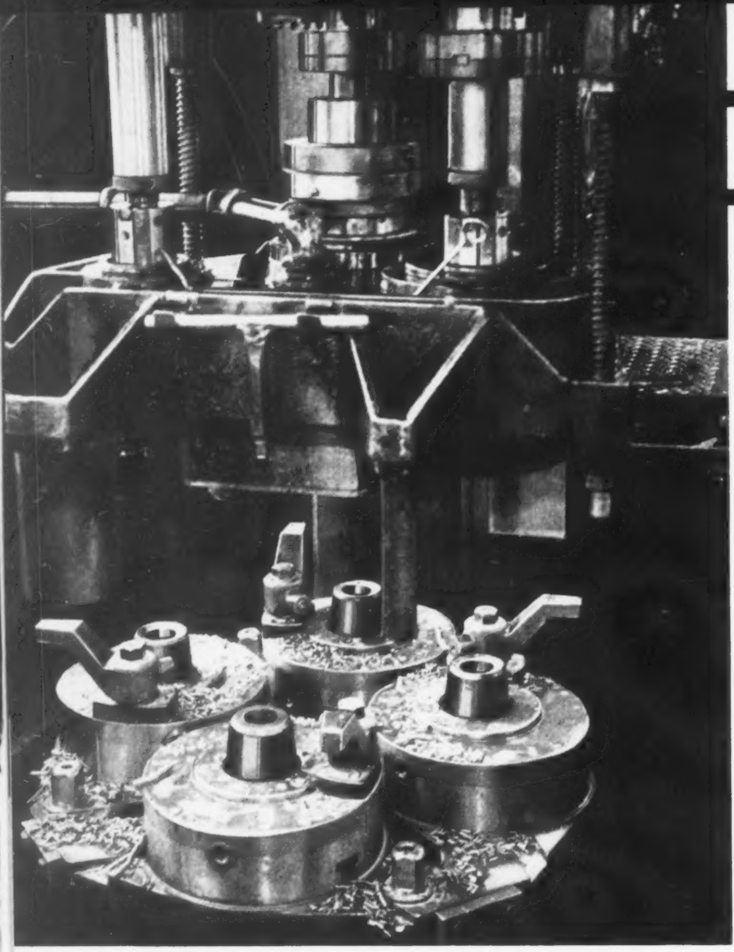
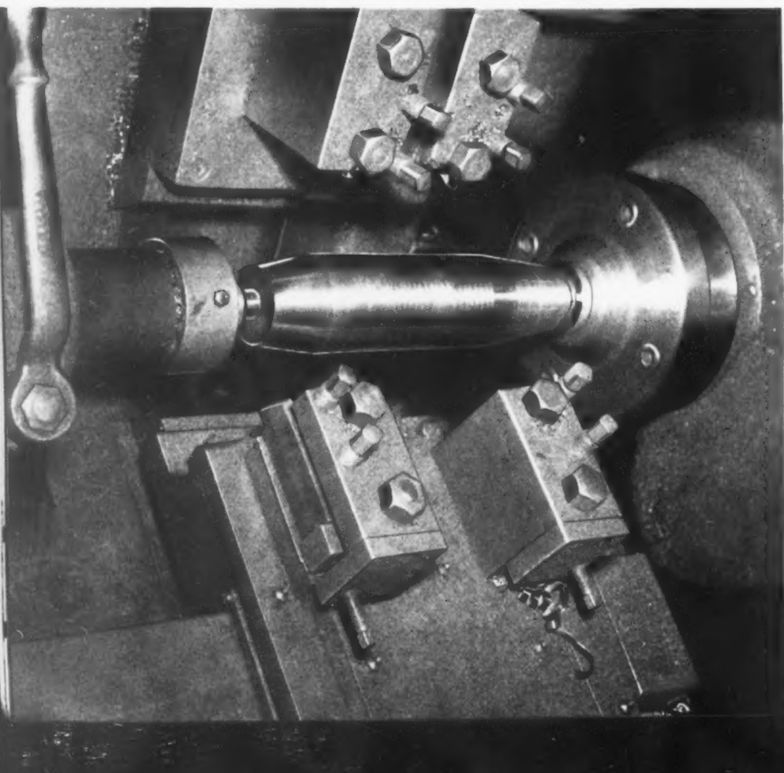


Fig. 9. Boring, Facing, and Turning the Nose End of the Shell in a Three-spindle Drilling Machine Equipped with an Indexing Table

NOW CANADA MAKES MUNITIONS

Fig. 10. The Shells are Finish-turned the Full Length in LeBlond Automatic Lathes. They are Machined Straight in the Center and Tapering at Both Ends



When the shells have attained the forging temperature, they are passed to an adjacent upright hydraulic press of 100 tons rating for the bottle-necking operation. For this operation, which is illustrated in Fig. 8, the taper surface of the base end is seated in a correspondingly shaped hole in a table fixture for locating purposes. The press ram is fitted with a die insert that shapes the nose end of the shell when the ram descends partially over the shell. Forming takes place on both the inside and outside of the shell forging.

The shells go next to a Natco multiple-spindle drilling machine, equipped, as shown in Fig. 9, for performing three operations on the nose end. From the loading station at the front of the table, the shells are indexed to the left-hand station where the fuse hole is bored, the end of the shell faced to length and to a conical seat, and the end of the shell chamfered along the outer edge. All the cutters are held on a bar that is accurately piloted by a large-diameter sleeve on the drill spindle engaging a long bushing in the bushing plate. The cutter-bars of the two following stations are similarly piloted.

In the next working station, at the rear of the table, a "scabbing" cut is taken on the inside of the shell to clean this surface to the end of the bottle-neck. The Carboloy tool employed for this cut is fed radially outward as it moves downward into the shell to suit the changing contour of the shell interior. Finally, in the next station at the right, the fuse hole is finish-bored by a tool having eight inserted blades of high-speed steel. Swinging gages mounted on the chucks permit of positioning the heights of the shells as they are loaded in the chucks through the medium of an inserted mandrel contacting the bottom of the shell cavity.

The shells next pass to LeBlond automatic lathes tooled up as illustrated in Fig. 10 for finish-turning. Two tools are mounted on the front carriage and two on the rear carriage. The left-hand tool on the rear carriage rough-turns the taper on the base end of the shell, while the right-hand tool finish-turns the nose end. At the same time, the left-hand tool on the front carriage finish-turns part of the straight portion of the shell and the taper at the base end. The right-hand tool finish-turns the straight portion from the point where the nose taper ends to the point where the left-hand cutter starts turning.

Stationary cam bars are provided for both the

front and rear carriages to control the movements of the three tools that take tapering cuts. These cam bars are connected to the tailstock and cause the tool-blocks to be fed forward or to be withdrawn, as required. Carboloy tools are employed for the four cuts. The shell is mounted on an air-operated expanding mandrel, and the tailstock spindle is also moved back and forth by air. Each machine finishes an average of thirty-eight shells per hour.

At this point in the manufacturing procedure, the marks placed on the billets to indicate the heat and mill in which the steel was produced, which have been machined off, are again stamped on, together with the code of the manufacturer in whose shop the shells are being made. The shells are also weighed on a Toledo scale to make certain that they are being produced within the specified weight limits.

The next machine in the line is the Barnes three-spindle drilling machine shown in Fig. 11, which is employed for recessing the base end of the shells. The shells are loaded in the idle station of the work-fixture at the front and indexed clockwise. In the first working station, at the left, a drill of approximately 1 7/8 inches diameter cuts away the center hole boss on the end of the shell and drills into the shell end to within 0.010 inch of the finished recess depth. In the second working station, at the back of the fixture, two cutters rough-bore the recess to within 0.008 inch of the finished depth and to a nominal diameter of about 2 inches. Then, in the third station, at the right, a four-bladed cutter finishes the recess to depth and to the specified diameter, both within 0.002 inch. The dimensions of this recess must be closely controlled on account of the close limits specified on the weight of the finished shell. The operation of the drill head on this machine and the indexing movement of the fixture are hydraulically controlled.

After another weighing operation, the shells go to Hepburn machines of the design illustrated in Fig. 12 for cutting a dovetail groove to receive a copper rifling band at the point where the straight external surface of the shell approaches the taper of the base end. In addition to the groove being under-cut at an angle along each side to form the dovetail, wavy annular ridges must be machined completely around the bottom of the groove to prevent the copper band from turning on the shell when it is discharged from a gun.

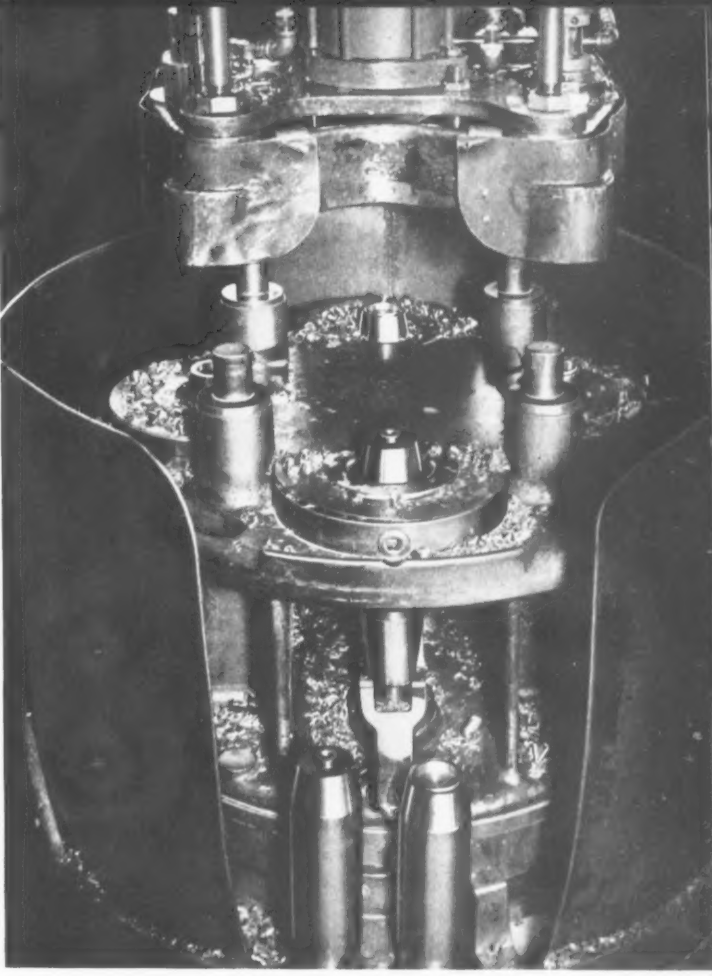


Fig. 11. The Recess in the Base End of the Shell is Produced Completely in This Three-spindle Drilling Machine Equipped with an Indexing Fixture

HOW CANADA MAKES MUNITIONS

Fig. 12. Ingenious Tooling Provided on a Special Machine Employed for Cutting the Dovetail Rifling-band Groove, with Its Wavy Annular Ridges, around the Shells

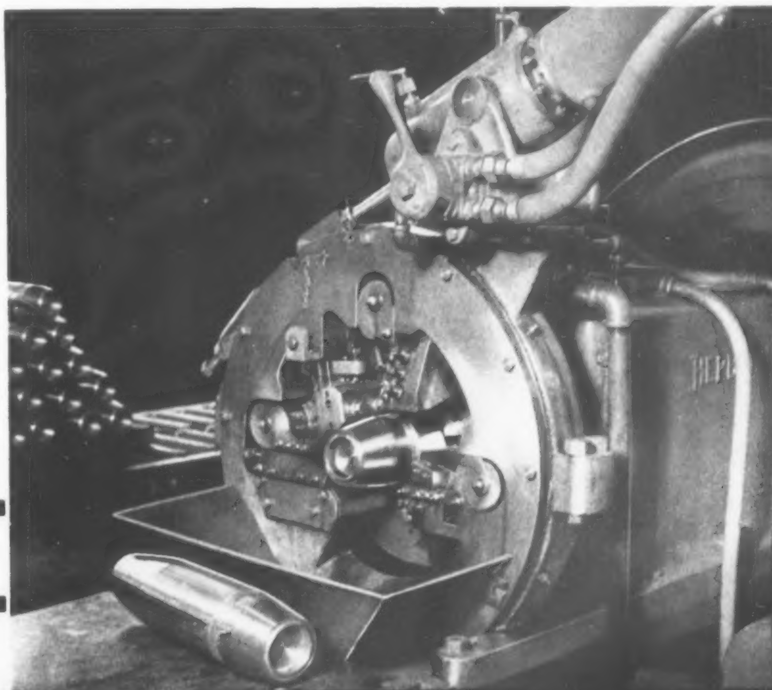


Fig. 13. Inspection of the Shell Cavity is Facilitated by the Use of a Small Electric Light Bulb Attached to a Hollow Rod

For this grooving operation, the straight portion of the shell is gripped by the jaws of an air-operated chuck. The cutting tools are mounted in three slides that are positioned radially around a head of "automotive brake" design which has a circular slide that is operated hydraulically to feed the three tool-slides radially toward the work.

On the front side of the tool-head (at the back as seen in Fig. 12) is a slide equipped with a tool that cuts the groove to approximately its full width at the top as it feeds into the work. The cutting edge of this tool is ground with two V-grooves which allow stock to remain at the bottom of the groove to form the wavy annular ridges. The "waves" are produced by sliding this tool-block sidewise three times during each revolution of the work. This oscillation is accomplished by a face-cam on the headstock spindle against which a roller attached to the grooving tool-slide rides under spring pressure. The sidewise oscillation imparted to the grooving tool is about 3/16 inch.

At the back of the tool-head is a slide provided with a tool that is fed toward the work at an angle of 20 degrees to under-cut the groove on one side. A similar tool above the work descends to cut the opposite side of the groove to the same angle, the two tools thus forming the dovetail. When the shell is taken from this machine, the operator applies a chisel and hammer to dent the wavy annular ridges at three points around the shell so as to provide vents for the escape of air from between the ridges when the copper rifling band is assembled.

Two sand-blasting operations on the shell interior follow the grooving. In each blasting operation, the shell is placed vertically within a sleeve on a slowly revolving table and a sand-blast nozzle is directed into the sleeve. Coarse grit is used in the first operation for a distance of about 4 inches from the nose end of the shell, and fine grit in the second operation, which finishes the interior to the bottom. Each sand-blasting operation lasts for about one minute. If any high spots remain after sand-blasting, they are ground away with a portable electric grinder. The shell is laid at an angle in a revolving sleeve for grinding. At the end of this operation, the interior of the shell must be completely free from any roughness.

Complete inspection then follows to check all dimensions and weight, and to detect any imperfections in the steel. Visual inspection of the shell interior is facilitated by the use of a small electric light bulb on the end of a hollow rod by means of which the light can be conveniently inserted into the shell. Such an inspection is being performed by the girl in the foreground of Fig. 13.

After this inspection, a steel plug is peened in the recess of the base end on a machine equipped with a fast reciprocating vertical spindle to which a peening tool is attached. The purpose of this plug is to prevent the shell from splitting within a gun barrel due to any leakage of gas through minute cracks in the end of the shell when the gun is dis-

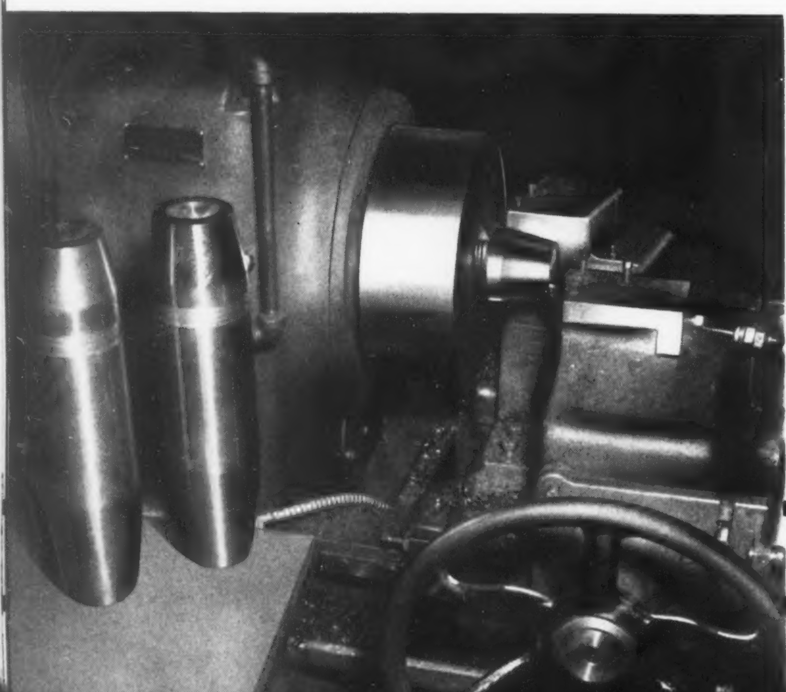


Fig. 14. Machine Employed for Finish-turning and Facing the Base End of the Shells after the Recess Plug has been Peened into the Shell End

Fig. 15. West Tire Setter, in which the Rifling Band is Squeezed Tightly into the Groove Prepared for it

charged. About 0.002 inch of clearance is allowed between the body of the plug and the recess in the shell.

A Williams automatic lathe is next employed to finish-turn the tapered base end and to face the peened surfaces of the shell and recess plug. This turning and facing operation is shown in Fig. 14. The major portion of the shell is inserted in the air-operated chuck of the headstock. A tool at the rear of the cross-slide is fed along the work at an angle of 10 degrees for turning the taper, and a second tool is fed crosswise for the facing cut. Carboloy-tipped tools are used in this operation.

Assembly of the copper rifling band is then accomplished in the West tire-setter machine illustrated in Fig. 15. For this operation, the copper band is slipped over the shell and into the groove, and the shell is placed upright in a bushing in the center of the machine. Six sliding jaws on the machine are then closed in on the shell, completely covering the copper band. The jaws are operated by individual hydraulic cylinders at a pressure of 1000 pounds per square inch and compress the band approximately 3/8 inch on the diameter. The band is about 1/16 inch larger in inside diameter than the straight portion of the shell prior to this squeezing process.

The copper band is next turned to the proper contour in the Hepburn lathe illustrated in Fig. 16, which is equipped with a special cross-slide that carries four tools. The operator moves the cross-slide in and out by hand to feed the tools to the work successively. First the cross-slide is fed forward into the position illustrated to bring a vertically held forming tool against the work for rough-turning the copper band. Then the operator moves the cross-slide into a central position and swings down an overhead arm that is equipped with two cutters for turning narrow flat surfaces on both edges of the copper band to a width of 0.020 inch. These tools are then again raised into the position shown, and the cross-slide is fed toward the rear to bring into action a form cutter at the front of the cross-slide which finish-turns an irregular surface around the copper band and cuts five fine annular grooves around one of the taper sides on the band.

Threads of Whitworth form are next milled in the nose end of the shell on a Morrison thread miller, as shown in Fig. 17. The work is accurately located for this operation in a revolving fixture that is well supported on the overhanging end. Loading is performed with the cutter-head withdrawn to the rear of the machine, so as to allow convenient insertion of the shell lengthwise into the fixture. When the shell has been loaded, the cutter-head is advanced in the crosswise direction until the hob can be entered into the work, after which the head moves longitudinally to a stop.

The cutter-head is then fed crosswise into the work to the desired depth of cut, while the work-head moves longitudinally to provide the required

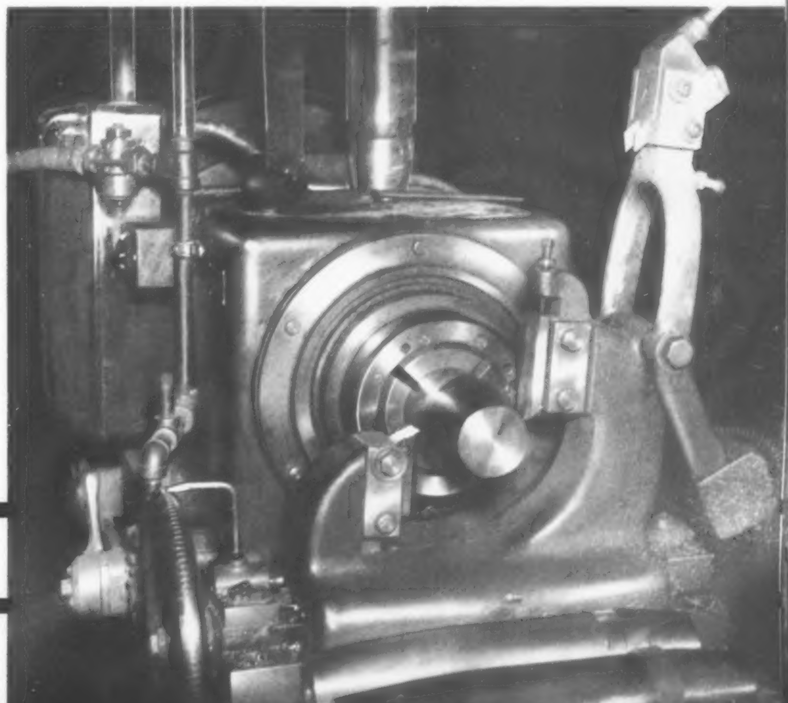


Fig. 16. Special Tooling Provided for Turning the Copper Rifling Band to an Irregular Contour and Cutting Fine Grooves around the Band

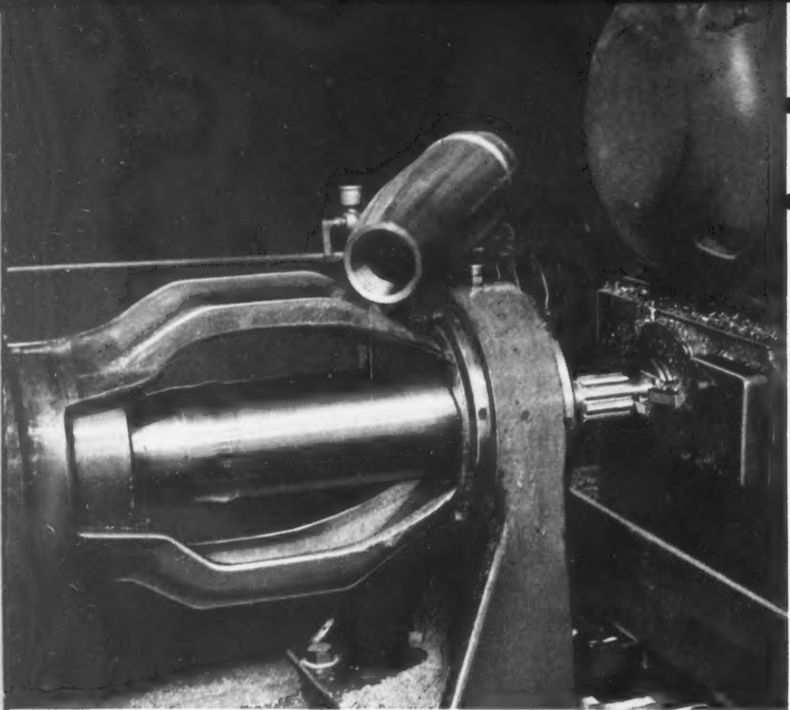


Fig. 17. The Threads in the Nose End are Milled and the Same End of the Shell is Spherically Faced on a Thread Milling Machine Equipped as Shown

thread lead, the work-head movement being controlled by a master lead-screw. At the end of the thread milling, a single-point tool (seen in front of the thread hob in the illustration) finish-faces a spherical seat in the open end of the shell to suit a corresponding surface on the fuse to be later assembled.

Thorough cleansing of the shells is then accomplished in a vapor type degreasing tank in which the vapor is produced from Royalene. The vapor is directed against both the inner and outer surfaces of the shell. The next operation consists of spraying a coat of varnish on the inside of the shells by employing machines of the type illustrated in Fig. 19. The shell is laid horizontally on revolving rollers that turn it at a medium speed while the operator gradually slides a long nozzle attached to a DeVilbiss spray gun into the shell interior. The workman in back of the machine is inspecting the varnished interior by holding a small electric light bulb at the top of the shell.

The varnish is dried by placing the shells in an oven maintained at a temperature of 300 degrees F. in which they remain for approximately two hours. The purpose of the varnish is to prevent corrosion and provide an insulation against static electricity getting into the explosive that is later loaded into the shell and exploding the charge.

Final checking of the shell by shop inspectors then follows, after which the shells are again completely examined for dimensional and physical imperfections by inspectors employed by the British Government. Then the shells are sprayed with paint, and plugs are screwed into the nose to prevent dampness from entering the shell interior before loading of the explosive.

The operations performed on the 3.7-inch shells are, in the main, similar to those employed in machining the 25-pounder shells. There are several operations, however, that differ in important respects. For example, rough-turning of these shells is performed in Fay 16-inch automatic lathes equipped as illustrated in Fig. 18.

Four tools on the front carriage are moved along the shell for the turning cuts. The two tools at the right move along a straight path, the third tool from the right is given an in-and-out movement to turn an irregular contour, and the fourth tool, at the extreme left, is fed forward at a constant rate for turning a taper on the nose end. The action of the third and fourth tools is accomplished through the use of a stationary former slide which extends through the carriage and against which the tool-slides are held by positive follower shoes. Two tools

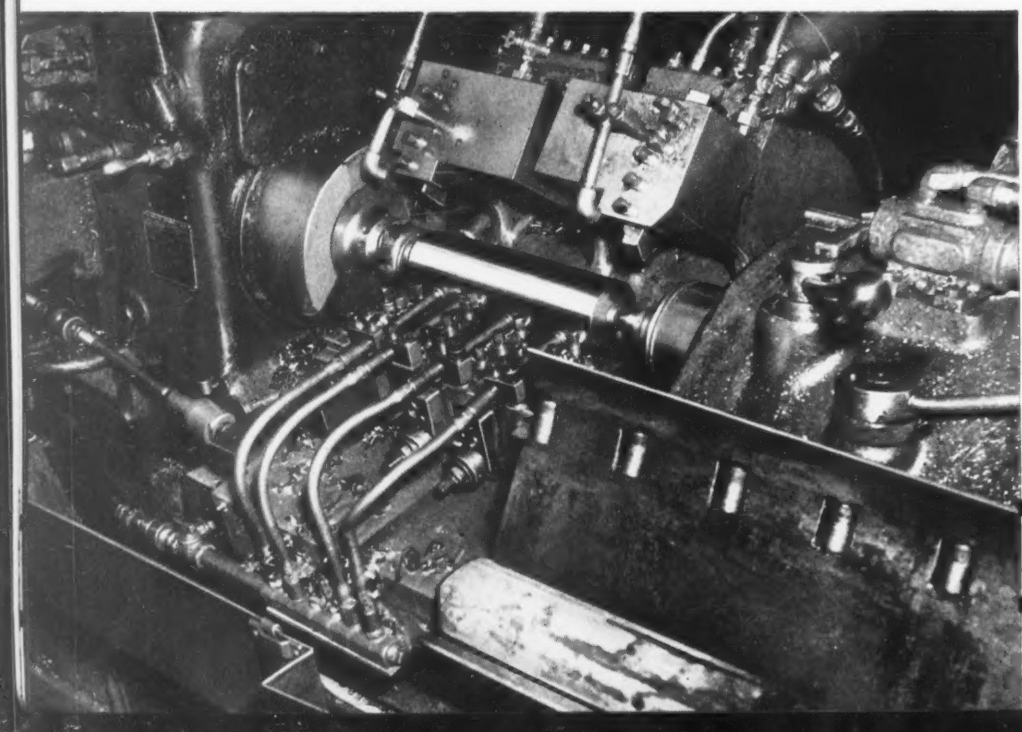


Fig. 18. Fay Automatics are Used for Rough-turning 3.7-inch Shells to an Irregular Contour, and at the Same Time, Facing the Base End and Cutting off the Nose End

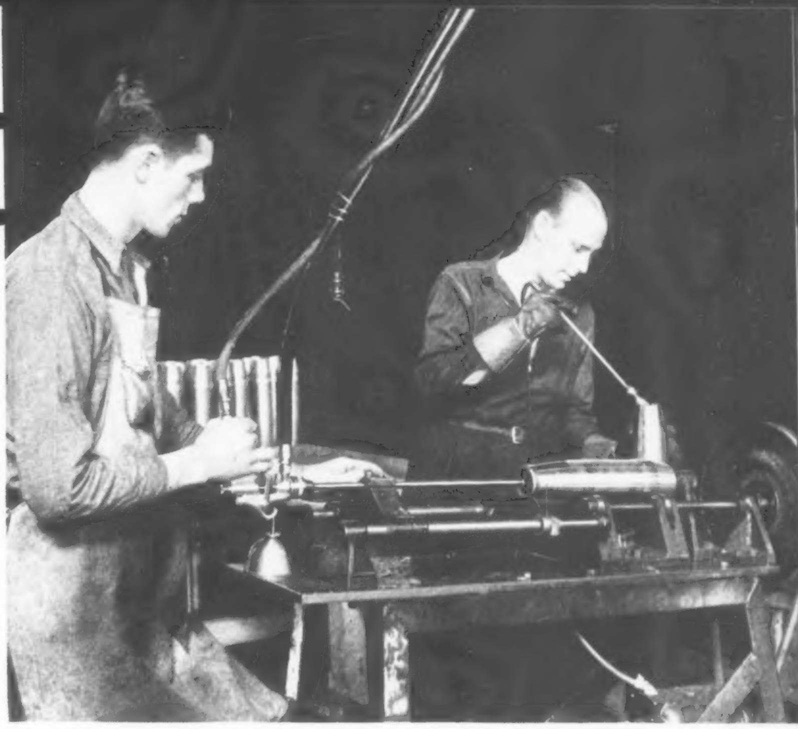


Fig. 19. The Cavity in Each Shell is Coated with Varnish by Means of a Spray Gun Provided with a Long Nozzle that can be Inserted in the Cavity for its Full Length

on the back carriages rock forward to face the base end of the shell and to cut off the open end to length.

A feature of this machine is the provision for quick reloading of the shells. At the end of an operation, the hinged tailstock automatically swings upward into the position shown in Fig. 20, so that the shell can be removed from the driving fixture attached to the headstock spindle and a rough forging slipped on this fixture without any endwise movement of the tailstock. When the tailstock swings upward, a sheet-metal trough at the front of the machine, which is fitted with conveyor rollers, automatically swings backward into line with the finished shell. The shell can then be pushed readily along these rollers and a rough forging previously placed on the trough slipped on the headstock fixture.

The tailstock then automatically swings forward into the working position and its spindle moves to the left to bring the center against the end of the newly loaded shell. The swinging action of the tailstock is accomplished by hydraulic power, and the gripping members of the fixture are also operated hydraulically. The tailstock spindle is advanced and withdrawn by hydraulic pressure. All the tools used on this machine are Carboloy-tipped.

Finish-machining of the base end of the 3.7-inch shells, including the cutting of the rifling-band groove and its wavy annular ridges, is performed on Acme-Gridley four-spindle automatics of the 3 1/2-inch size tooled up as illustrated in Figs. 21 and 22. At the start of this operation, the finish-turned shell is laid on a rest in the lower position of the machine and slipped by hand part way into the chuck and over a centering bar that enters the shell cavity. Then a ram is automatically operated horizontally from the left-hand end of the machine to push the shell completely into the chuck. The shell is gripped securely by the chuck just before the spindle carrier indexes. In Fig. 21, a finished shell is seen lying on the rest, and the loading ram may be seen to the left of the shell.

In the lower front position of the automatic, which may be seen in Fig. 22, a form cutter mounted on the side slide turns a half-round choke groove around the shell near the base end and turns the groove for the copper rifling band to depth, ready for machining the wavy annular ridges and the dovetail under-cuts. The shape of the form tool will be seen from diagram *A*, Fig. 23. While the turning operation is taking place, a 1 1/2-inch drill on the end tool-slide in the lower front position cuts away the boss on the base end of the shell and

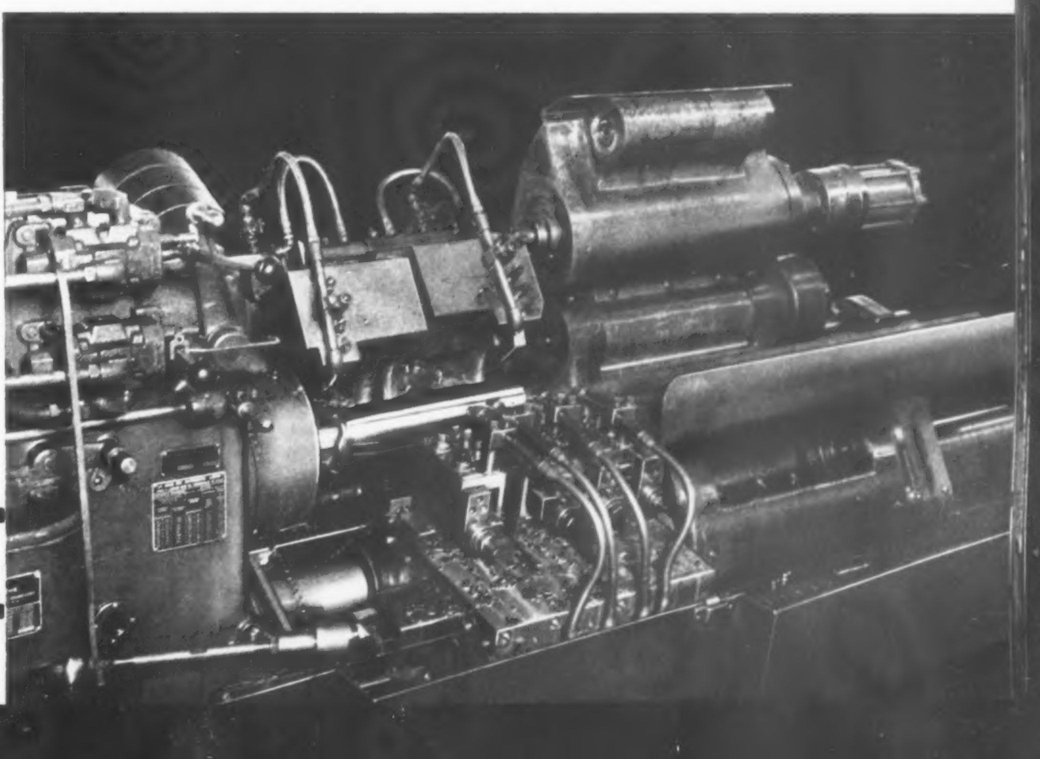


Fig. 20. The Tailstock on the Fay Automatic Shell-turning Lathes is Automatically Swung up by Hydraulic Pressure to Facilitate Loading the Shells on the Headstock Mandrel

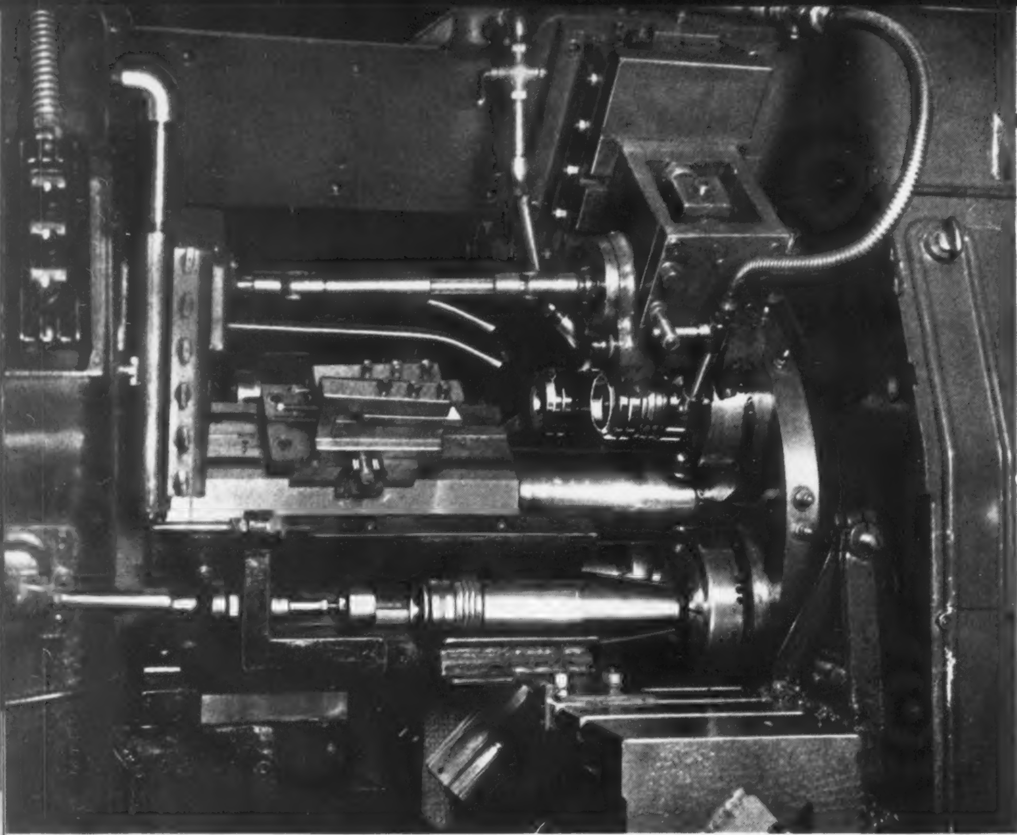
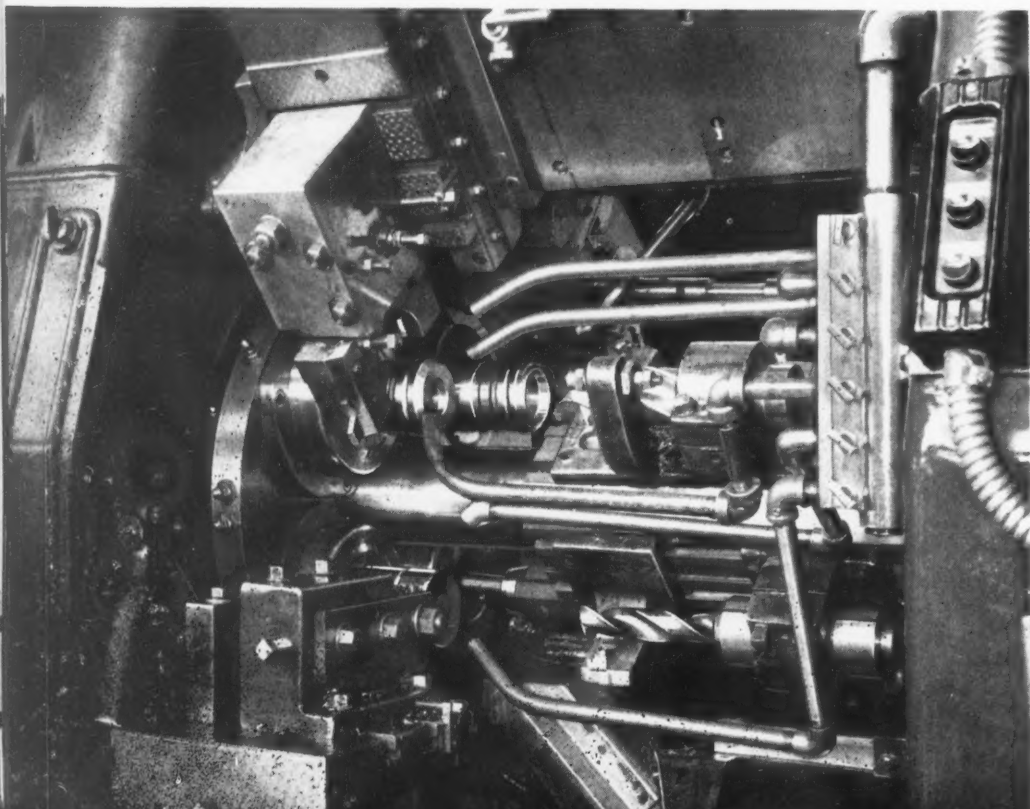


Fig. 21. Acme-Gridley Automatics are Employed for Machining the Choke Groove, the Dovetail Rifling-band Groove with its Wavy Annular Ridges, and the Base Recess in 3.7-inch Shells

Fig. 22. Front View of the Acme-Gridley Automatic Employed for Turning the Shell Grooves and Base Recess Showing the Tooling in the First Two Working Stations

starts to form the recess. A form tool held on a knee-turner, also mounted on the end slide, rounds the corner of the shell and turns the crimping lip on the face.

In the upper front position of the machine, which is also seen in Fig. 22, the side slide is equipped with a fixture that supports cutters on opposite sides of the shell and feeds these cutters downward into position and then successively sidewise in opposite directions to under-cut both sides of the groove so as to produce the dovetail shape. These cutters are shown diagrammatically at *B*, Fig. 23. At the same time, a 3-inch drill on the end slide advances to machine the recess to its approximate diameter, and a cutter on a knee-turner mounted in the same position of the end slide finish-turns



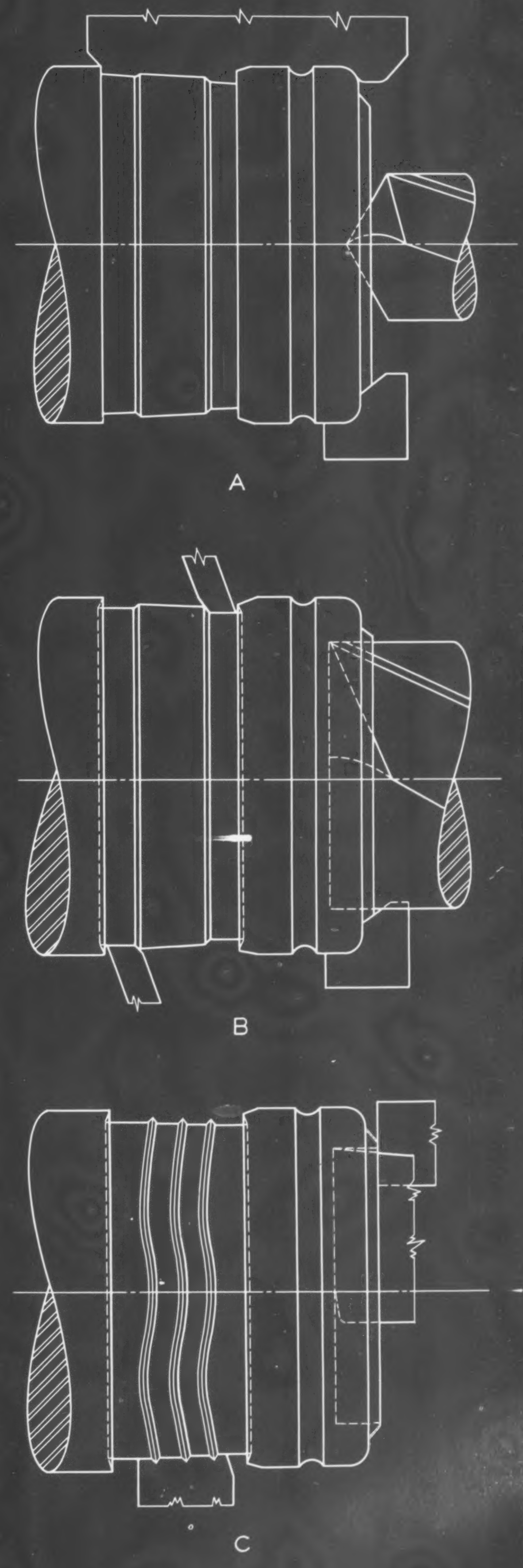
the rounded corner of the shell and the crimping lip as well.

The wavy annular ridges in the rifling-band groove are machined in the upper back position of the automatic, which, as shown in Fig. 21, is provided with a special tool fixture. This fixture is reciprocated sidewise three times during each revolution of the work, so that "waves" are machined by a form tool mounted on the fixture. The shape of the cutting edge on this tool will be apparent from diagram *C*, Fig. 23. Reciprocation of this tool is effected by the rotation of a small drum cam in the special fixture which is driven from the headstock of the machine.

While the wavy annular ridges are being turned, the recess in the base end of the shell is bored to the finished dimensions by a single-point tool mounted on the end slide, and the crimping lip is faced by a second tool also mounted on the end slide. When the finished shell is indexed into the lower back position of the machine, it is automatically released by the chuck jaws, after which the centering bar within the chuck moves automatically toward the left to push the shell out of the chuck and on the loading and unloading rest, as shown in Fig. 21.

Men familiar with the manufacture of shells of comparable sizes during the last World War will realize from the foregoing that important changes in manufacturing practice have greatly expedited production rates without any sacrifice in the quality of the shells.

Fig. 23. Diagrams Showing the Tooling Provided in the Three Working Stations of the Automatic Illustrated in Figs. 21 and 22

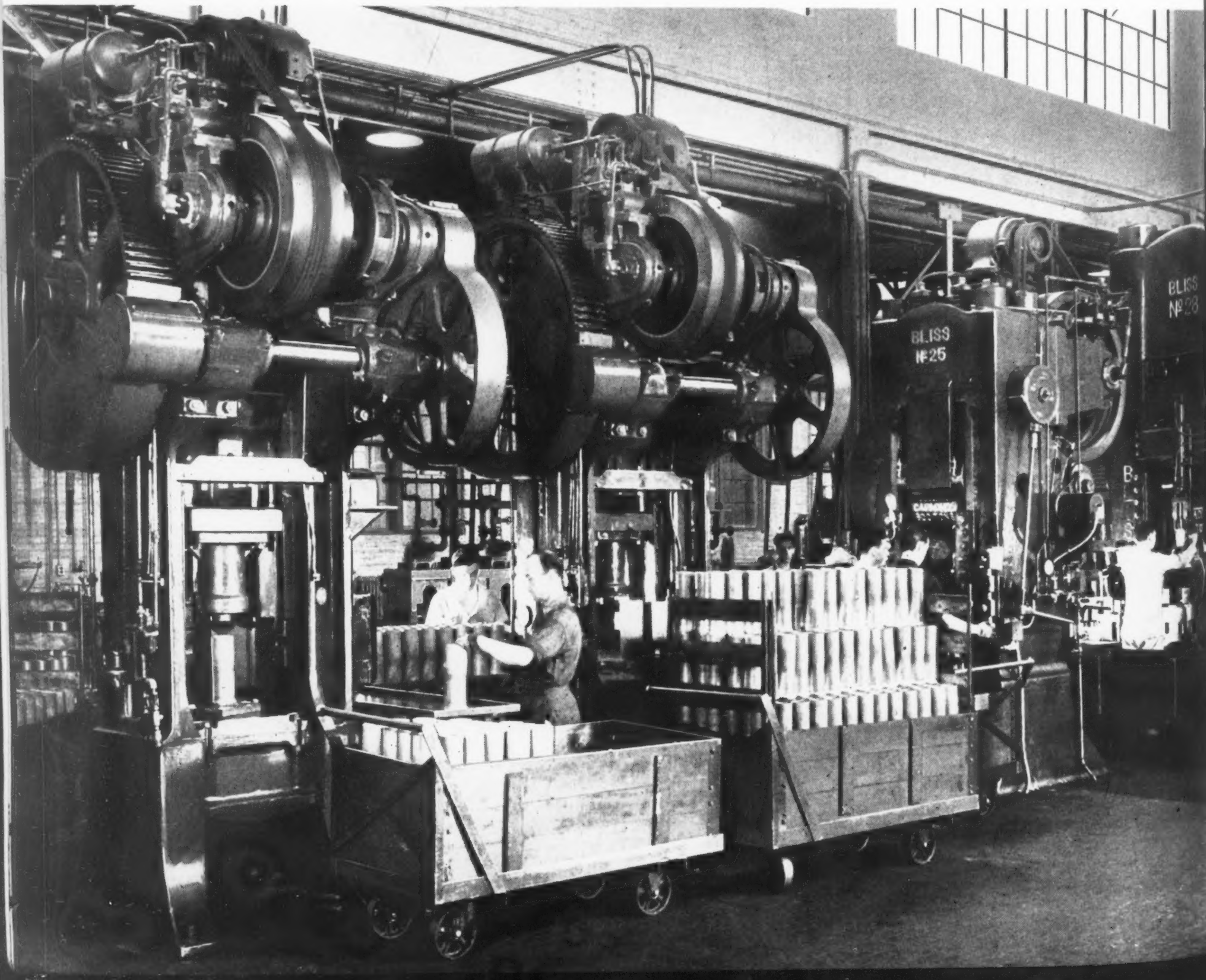


Cartridge Cases FOR

CARTRIDGE cases for 25-pounder shells are being produced on a high-quantity basis by a shop in Quebec which achieved distinction by equipping a complete plant for this purpose with machines, furnaces, tools, dies, and gages, and attaining full-production operation within five months from the day the shop was invited to tender a bid. This plant is now producing over 40,000 cartridge cases per week for 25-pounder shells.

As a matter of general information, it is interesting to know that the shells and the cartridge cases for 25-pounder artillery are loaded separately in the guns. This practice is in marked contrast to the method of loading the famous 75-millimeter guns used by the French and American forces in the first World War, and the 18-pounders, which were the standard British field guns up to three years ago. For this older artillery, the ammunition was "fixed." The cartridge case held a definite charge of explosive and was crimped to the end of the shell, so that the shell and the cartridge case were loaded as one piece into the gun. The advantage of using separate ammunition is that the charge can be varied.

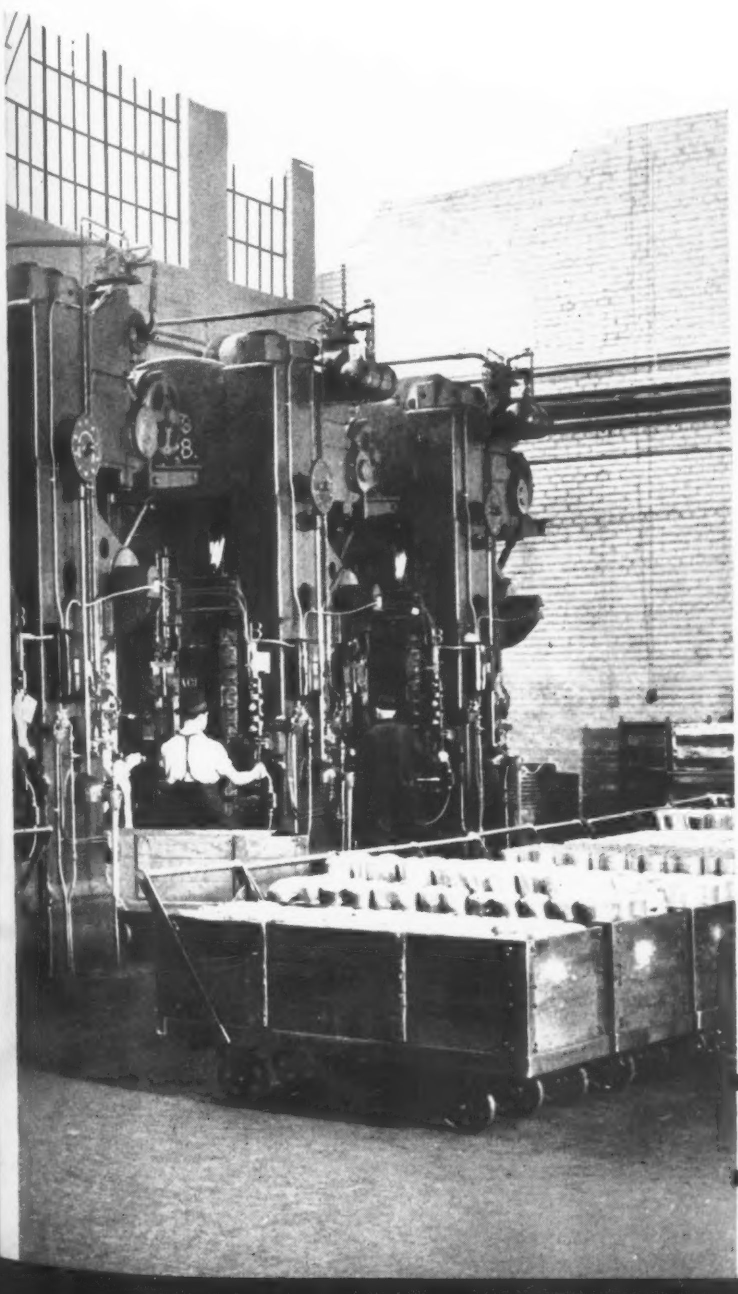
The 25-pounder cartridge cases are produced from disks of brass 6.290 inches in diameter by



25-POUNDER SHELLS

0.525 inch thick. The brass from which the disks are produced is rolled in the mill to the thickness mentioned, annealed in the strip, and blanked on presses. Successive steps in the production of cartridge cases, from the brass disk to the completed piece, are indicated in Fig. 1.

The first of these operations consists of drawing the disks to a cup shape, as shown at *B*, Fig. 2, on a Bliss press of 200 tons capacity. The cup is approximately 3 15/16 inches inside diameter, 4 3/4 inches outside diameter, and 2 3/8 inches deep. Following the cupping operation, the cases are annealed to soften the material for the next draw, after which they are pickled to remove scale and dirt. This annealing process, which will be described later, follows each drawing operation, and pickling follows each annealing.



The press employed for cupping the disks is also used for the first draw, it being the practice to run a considerable number of pieces through one of these operations and then change the punch and die for performing the other operation.

Fig. 3 shows the press set-up for the second draw. In the operation, a man at the front of the press dips the cupped pieces into soluble oil to insure adequate lubrication of the punch, die, and work during the operation. He then lays the dipped cup on a long narrow tray leading to the die-block. A second man at the front of the press inserts the cup into the die between strokes of the press, which operates continuously.

The punch pushes the cup completely through the die, the cup rolling through an opening in the back of the die-block to a third man who stacks the cases into a truck to be transferred to the annealing furnace. Each cartridge case is stripped from the punch on the up stroke by a finger at the inner end of a horizontal spring-actuated plunger. The end of this finger rides against the side of the cartridge case from the bottom to the upper end during the operation, and then jumps over the top of the case as it is forced past the finger, thus preventing the case from moving up with the punch on the return stroke. The finger is rounded on top, so that it is readily pushed back by each descending cartridge case, but is flat on the bottom side, and thus cannot be pushed back by a case adhering to the punch on the up stroke. With the exception of the die insert and punch, the same equipment is employed for the cupping operation.

At the end of the first draw, the cartridge case is approximately 3 3/4 inches inside diameter, 4 7/16 inches outside diameter, and 3 inches long, as indicated at *C*, Fig. 2. After annealing and pickling, the cartridge case is drawn to the approximate dimensions shown at *D* with the equipment illustrated in Fig. 3.

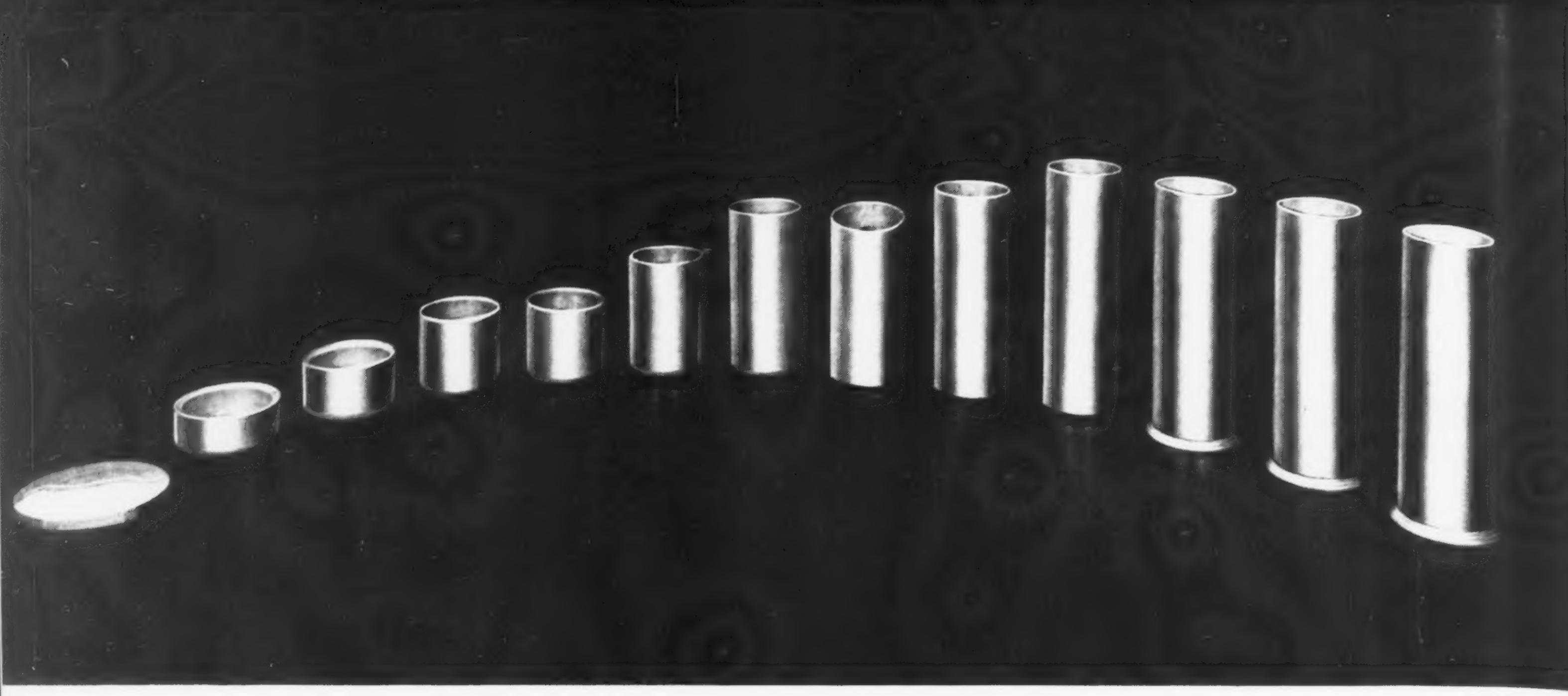


Fig. 1. Successive Steps in Producing a 25-pounder Cartridge Case, from the Brass Disk to the Completely Drawn and Headed Case

After again annealing and pickling, the cartridge case goes to a Bliss press of 600 tons capacity, equipped as illustrated in Fig. 4 for flattening and indenting the base end, as indicated by the cartridge case seen lying on the left-hand side of the die fixture. This fixture is of the two-station type, the work being loaded into a die at the front of the press and then indexed through 180 degrees to locate it under the press ram. Unloading and working of two cartridge cases is, of course, performed simultaneously. Each cartridge case is formed on the bottom end in the operation approximately as indicated by the diagram at *E*, Fig. 2.

The center of each die is fitted with a plug of approximately the same diameter as the inside of the cartridge case, which is made with a depression at the upper end in which the indent is formed by the descending punch. The external cylindrical surface of the cartridge case registers against the die sleeve. These indenting die holders are equipped with springs that raise them from the fixture when the ram of the press rises, thus reducing friction in the indexing of the die-holder, which is performed by hand.

The cartridge cases go next to the third drawing operation, which is performed on a 100-ton hydraulic press built in Canada, of similar construction to the machine shown in Fig. 5. In this operation, the cases are drawn to the approximate dimensions shown at *F*, Fig. 2. Then, after annealing and pickling, the cartridge cases are put through a fourth drawing operation performed on a hydraulic press of 100 tons capacity. Except for length and diameter, the punch and die used in the fourth operation are similar to those seen in Fig. 5, which actually illustrates the sixth drawing operation. This is also true of the equipment employed in the fifth draw. A hydraulic press of 50 tons capacity is used for the fifth and sixth drawing operations.

The dies employed in the fourth, fifth, and sixth drawing operations are made with a circular depression or well in the top, in which a supply of soluble oil is maintained, so as to completely cover the punch on its up stroke and thus provide adequate lubricant for the working stroke. The cartridge case is dipped in soluble oil before being placed in the die, as in the case of all drawing operations performed in this shop. This practice is of utmost importance in drawing the cartridge cases successfully to their final length and thin wall section.

As in the drawing operations previously described, the cartridge cases fall through the die bolsters and are loaded by a man at the back of the press into trucks. Stripping devices on the dies prevent the cases from rising with the punch. In all the hydraulic presses, there is a rapid approach of the punch to the cartridge case and then a slow movement for effecting the draw. Diagrams *G*, *J*, and *K*, Fig. 2, indicate the approximate dimensions of the cartridge case after the fourth, fifth and sixth draws, respectively. A number of other operations, however, occur between the fourth, fifth and sixth draws.

After the fourth drawing operation, the cartridge cases are trimmed to length in machines of the construction shown in Fig. 7, which were designed and

built by a Quebec firm. Each case is slipped over an arbor attached to the headstock spindle, and the excess stock at the open end is cut off by feeding a circular cutter at the front of the cross-slide against the revolving case. This cutter is about 4 inches in diameter, and is ground at an angle of 45 degrees to a knife-edge. The slide is fed against a stop, which permits the tool to cut through the brass wall of the cartridge case, but prevents it from cutting the hardened steel ring provided on the arbor in line with the tool. The tool is mounted on Timken roller bearings to enable it to revolve freely with the work. Adjustments are provided to regulate the thrust on these bearings.

When the excess stock has been severed from the cartridge case, the cross-slide is fed forward, bringing a hardened roller at the back into firm contact with the trimmed end of the cartridge case and rolling down the small raised edge produced in cutting off. No chips are produced in this operation, and there are no burrs. The roller is about 4 inches in diameter by 1/2 inch wide, and is also mounted on Timken roller bearings. The wall of the cartridge case is about 3/32 inch thick where it is trimmed off.

Before this method of trimming was adopted, the engineers responsible for its development were told that the method would not prove practical; but experience has proved that each machine of this type in the plant can be operated to trim 360 cartridge cases per hour by a man having only a limited amount of training.

The cartridge cases are passed from the trimming operation to a Bliss press of 1200 tons capacity, which is similar in appearance on the loading side to the press shown in Fig. 6, but is equipped with two indexing punches as illustrated in Fig. 9. This illustration was taken from the back of the press. After a cartridge case is loaded in one of the two dies, the die fixture is automatically indexed by a mechanism at the rear of the press to bring the cartridge case into position beneath one

Fig. 2. Diagrams that Indicate the Approximate Changes Made in the 25-pounder Cartridge Cases by the Successive Press Operations

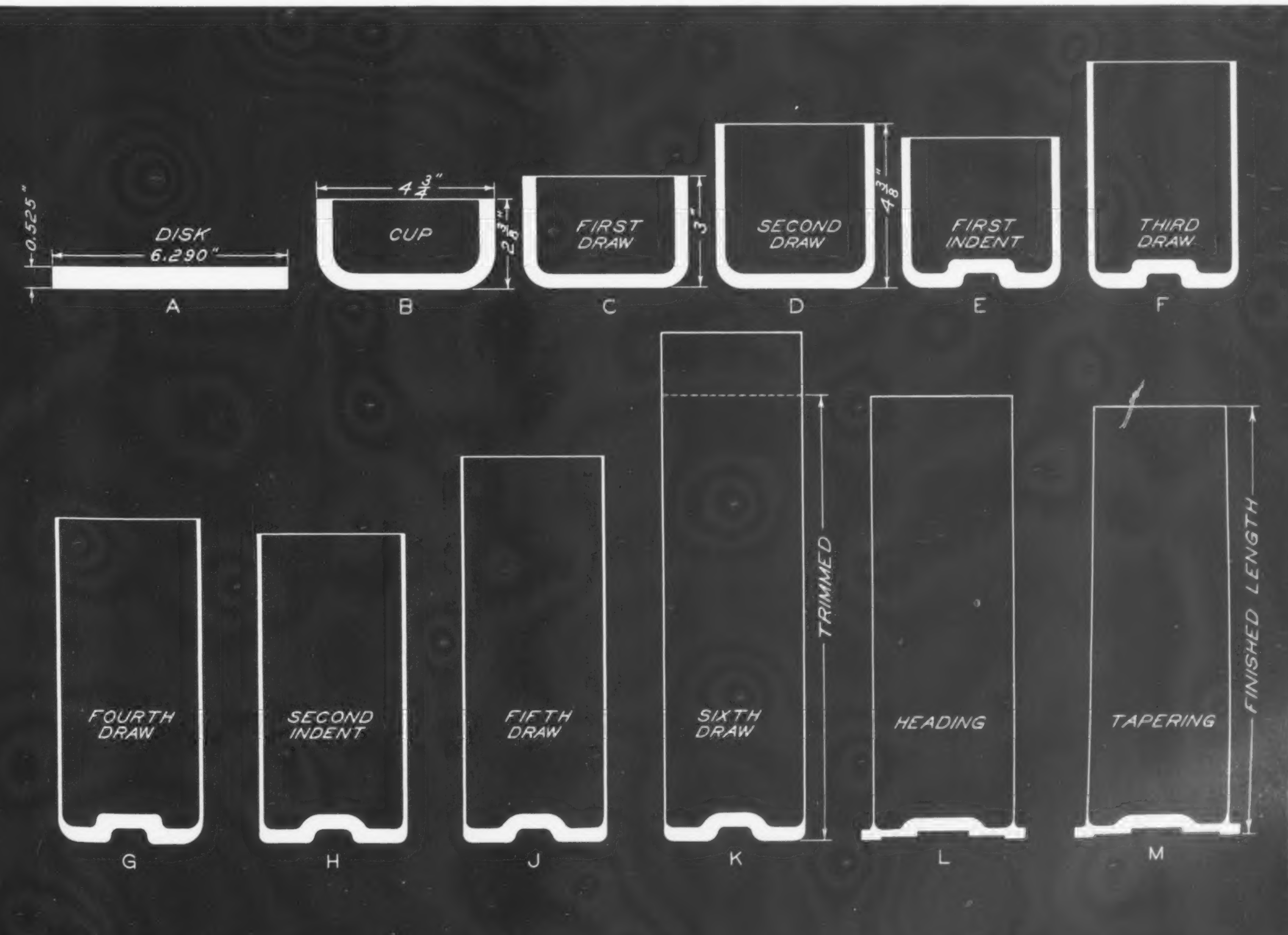


Fig. 3. The Punch and Die Equipment Provided on a Mechanically Operated Press to Perform the Second Draw on the Cartridge Cases

of the punches, as shown in Fig. 9. Then the press ram is operated to bring down the punch that is over the work and die for flattening the base end of the cartridge case.

When the press ram rises again, the operator moves a lever at the right on the front of the machine, causing the punch-holder to slide sidewise and thus bring the second punch into position above the work. The operator then causes the press ram to descend a second time for further indenting and forming the base end of the cartridge case, both on the outside and the inside. Both punches are made with a short projection on the lower end which registers in the indent previously made.

As in the first indenting operation, each die is made with a plug in the center that has a depression in the upper end to suit the previous indent in the cartridge cases, and the outside wall of the cartridge case contacts with the die sleeve. The die indexing mechanism is air-controlled. It is electrically interlocked with the ram operating mechanism, so that the ram cannot be operated unless the dies and punches are in their proper positions.

NOW CANADA MAKES MUNITIONS

The cartridge cases then go to the fifth and sixth drawing operations, being, of course, annealed and pickled after the fifth draw. Following the sixth draw, the cartridge cases are trimmed a second time on machines of the same design as the one shown in Fig. 7, and a 1/8-inch hole is drilled in the center of the base end. The cartridge cases are now transferred to the Bliss 1200-ton press, shown in Fig. 6, for heading the closed end. This is a rather severe operation and requires just about the full capacity of the press to shape the closed end as indicated by the two cartridge cases lying at the front of the press in the illustration.

The press is equipped with an indexing fixture for the two dies which is indexed mechanically, as

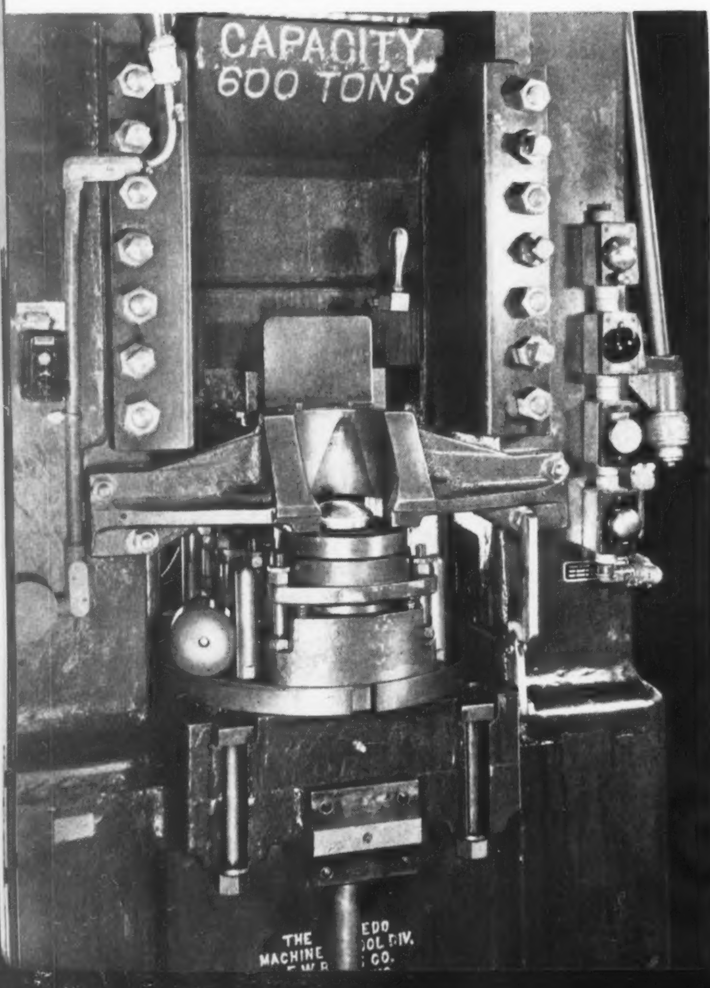


Fig. 4. Front of the Press Used for the First Indenting Operation on the Cartridge Cases. Showing the Indexing Die Fixture Provided

25-POUNDER SHELLS

Fig. 5. Punch and Die Equipment Used on a Hydraulic Press for the Sixth Drawing Operation; also Typical of That Used for the Fourth and Fifth Draws

in the case of the second indenting operation. Only one punch is used in this instance, although a handle may be seen at the right, extending to the front of the press, for indexing two punches. On this press, as well as on those employed for the first and second indenting operations, a mechanical knock-out raises the cartridge cases out of the dies.

The work is automatically lifted from the deep dies on the heading press, however, by an air-operated pick-up at the front of the press. This device lowers two fingers on a ram that slip under the flanged head of the cartridge case and pull it upward with the return stroke of the air piston. Each cartridge case is taken from this pick-up device and loaded on a truck. Two men stand at the front of both the indenting presses and the heading press, one man being kept busy loading cartridge cases in the dies and the other removing the cases as they are indexed to the front of the press.

All of the press operations described had to be so planned and the punches and dies so designed as to insure proper distribution of the drawn metal in the cartridge cases. When the cases reach the heading operation, the brass at the closed end must be thicker than that of the original disk from which the case was produced. The small hole drilled prior to heading serves as a vent to allow air to escape from the inside of the cartridge case and to permit the proper flow of metal, an important factor in obtaining even metal distribution in this operation. The tolerance on the body diameter of the cartridge case underneath the head after the heading operation is plus or minus 0.005 inch.

The annealing operations that follow the various draws are conducted in pusher type furnaces of Holcroft design, built in Ontario, the cartridge cases being loaded on sheet-steel trays for this operation. The furnaces are about 25 feet long in-

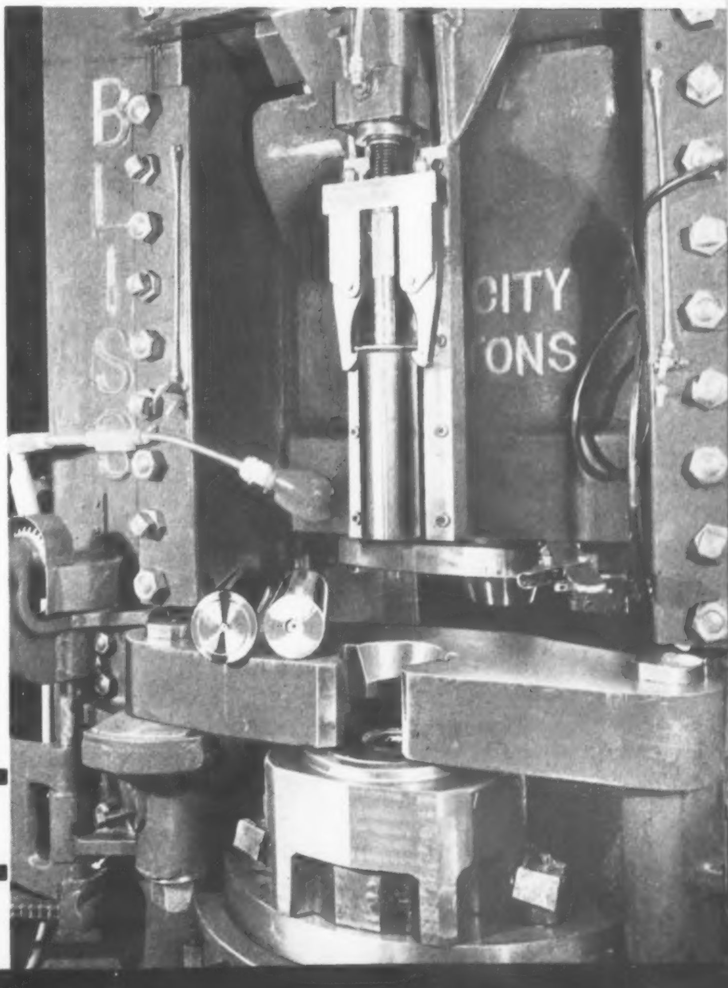


Fig. 6. The Heading Press is Provided with an Automatic Air-operated Unloading Device that Lifts the Cartridge Cases from the Deep Dies

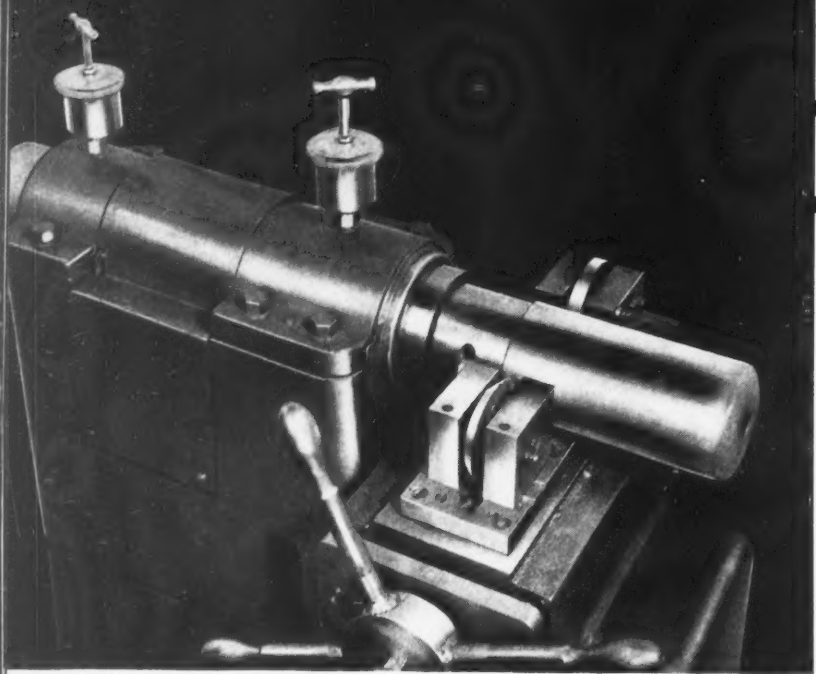


Fig. 7. Simple Machine of Ingenious Design Employed for Performing Two Trimming Operations on the Open End of the Cartridge Cases

side, and are arranged for handling two rows of trays side by side, as will be apparent from Fig. 8, which shows the discharge end of one of the furnaces. A higher temperature is maintained at the charging end of these annealing furnaces than at the discharge end, where an annealing temperature of about 1200 degrees F. is maintained.

Depending upon the draw to which the cartridge cases have been subjected, the cartridge cases stay in the furnaces for forty-eight, sixty or seventy-two minutes, it being possible to change the cycle of furnace operation through a variable electric timing device. The furnaces are oil-fired, and each furnace is equipped with a duplicate set of pumps to insure a supply of oil in the event of a pump breakdown.

At the discharge end of the furnaces the trays of work are slid on a roller-equipped table attached to an overhead air hoist and immediately lowered a distance of about three feet by the hoist into a water quenching tank. When the cartridge cases are raised from the quench, they are transferred to a pickling tank containing a dilute solution of sulphuric acid for loosening all scale. The cartridge cases are then rinsed in water, brushed, and returned to the press department. Annealing is of great importance in cartridge case production, because successful drawing cannot be performed if the brass is either to hard or too soft.

Immediately after the heading operation, the cartridge cases are annealed at the mouth end preparatory to tapering the mouth. This annealing is performed with the special equipment shown in Fig. 10, which consists of nine slowly revolving tables with twelve staggered jets of gas flames located above and around each table. The cartridge cases are loaded on these tables and permitted to revolve until they reach a suitable temperature, as judged by their color. They are heated to this temperature for a distance of about 4 inches from the mouth end. The revolving tables are adjustable for height, as the extent of the heated area must be closely controlled, so as to insure graduated hardness readings from the mouth of the finished cartridge case to the base end. This mouth annealing furnace was designed and built by a Quebec firm.

Next the mouth is tapered by the use of two Toledo presses of 50 tons capacity equipped as

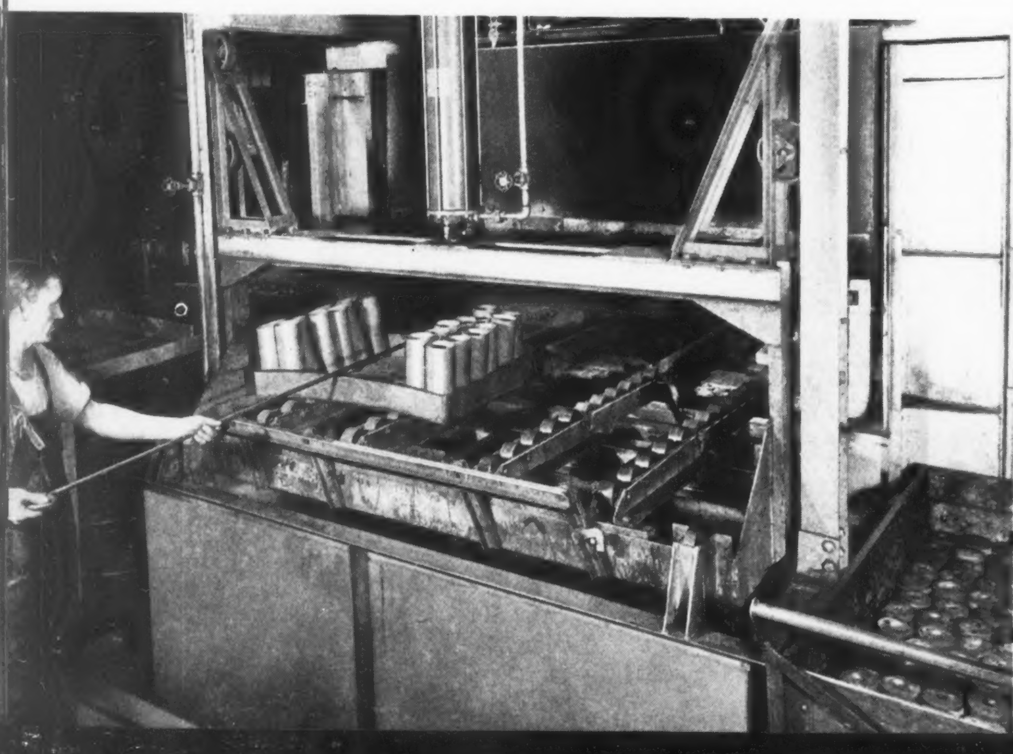


Fig. 8. Discharge End of the Furnace in which the Cartridge Cases are Annealed after Each Drawing Operation has been Performed

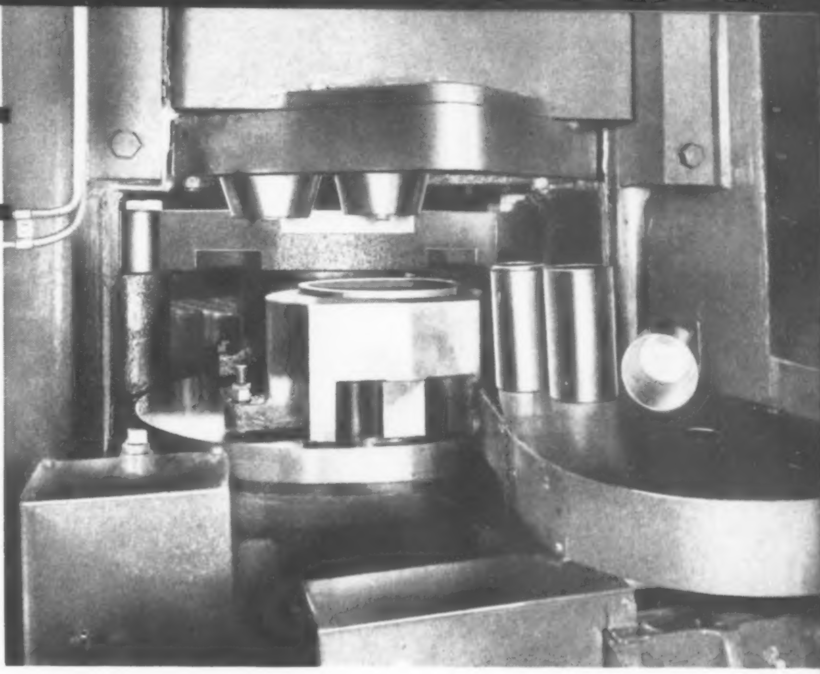


Fig. 9. In the Second Indenting Operation, which also Flattens the Closed End of the Cartridge Cases, Two Indexing Punches are Used

shown in Fig. 11. The cartridge case is positioned on a circular plate beneath the press ram, the ram being fitted with a plug that enters the cartridge case, and also with a tapered die ring that slides down along the outside of the case and gradually squeezes it inward to form the required taper. Each cartridge case is tapered for one-half its length by the first press and then immediately tapered to its full length by the second press. The cartridge cases are ejected from the die by the plug on the ram when the ram rises after each operation. Upon the completion of the foregoing operations, the cartridge case at the mouth end is almost a feather edge.

In addition to the press equipment referred to, there is an auxiliary Bliss press of 1200 tons capacity which is fitted with two indexing punches for performing either the first indenting or the heading operation in the event that either of the presses normally used for those operations should fall behind production schedules. Both punches are always in place on this auxiliary press ready for use, but the die inserts must be changed to suit the operation that is to be performed.

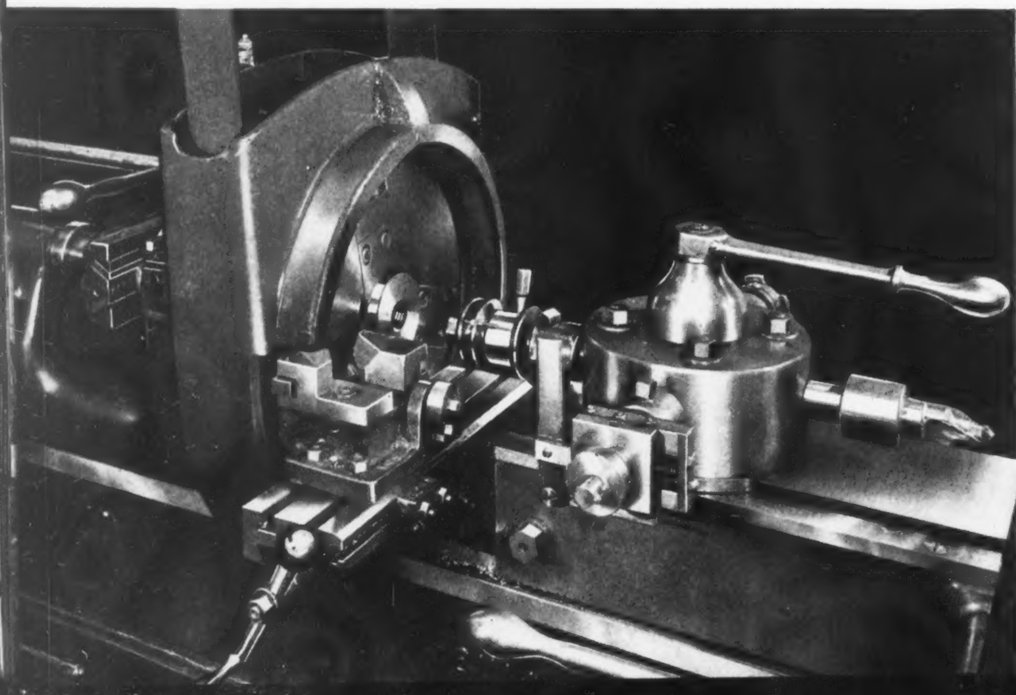
After the mouth tapering operation, the cartridge cases go to a battery of horizontal turret lathes of the Bullard design, illustrated in Fig. 12. These machines are provided with a turret to the right of the headstock, as on conventional machines of this type, but in addition, they have a tool-slide at the left-hand side of the headstock. The cartridge case is slipped on an arbor that extends through the chuck. This arbor also serves as a stop against the inside of the base end of the cartridge case to locate it endwise, and as a knock-out for pushing the cartridge case from the arbor when the operation has been completed. The three chuck jaws which grip the outside of the cartridge case are lever-operated.

In operation, the cartridge case is pushed into position on the arbor by advancing a drill on the turret against the headed end of the case. When the cartridge case has been gripped by the chuck jaws, this drill is advanced further to bore the indent to a diameter of approximately 1 inch. The operator then applies tools at the front of the cross-slide to face the head of the cartridge case and form the circumference of the head.

Fig. 10. Machine in which the Cases are Revolved past an Annealing Gas Flame Preparatory to Tapering the Mouth End

Fig. 11. The Mouth End of the Cartridge Cases is Tapered in Two Operations Performed on Presses Equipped as Shown

Fig. 12. Turret Lathe Provided with a Turret and Cross-slide at the Right-hand Side of the Headstock for Machining the Base End of Cartridge Cases, and with an Auxiliary Slide at the Left-hand Side of the Headstock for Trimming the Mouth End



Next, the mouth end of the cartridge case is trimmed by a tool mounted on the slide at the left-hand side of the headstock, after which the recess hole in the base end is reamed by a tool on the turret. Then the hole in back of the recess is tapped with Whitworth threads by a collapsible tap on the turret. The threaded hole is about 1/2 inch long. Finally, the recess is chamfered at its outer and inner ends by tools on a slide mounted on the front of the turret, as seen in Fig. 12. This slide is operated by a handle to feed the tools radially after they have been fed into position with respect to the work longitudinally.

The holder of the facing tool is so designed that the tool can be relieved at the end of its cut by the operator swiveling a small knob. The forming tool is made of Carboloy.

A tolerance of only 0.004 inch is allowed between the high and low limits on the pitch diameter of the threads, and they must also be true with the primer hole within close limits. To insure this accuracy, a hand tapping operation is performed immediately after the turret lathe operation, the cartridge case being slipped vertically into a bench fixture for the tapping. A bushing plate with a ground boss that fits the recess in front of the tapped hole in the cartridge case is positioned on the head of the cartridge case to guide the tap. The thread is then sized with the cartridge case held on a machine of simple design. In this case, a bushing plate is fitted on the base end of the case and into the primer seat to guide the tap accurately with respect to the primer seat.

Information pertaining to the size of the cartridge case, the shop in which it is made, etc., is then marked on the base end of the cartridge cases by the Noble & Westbrook machines seen in Fig. 13. For this operation, the cartridge case is slipped on an arbor that can be tilted forward, as seen at the

Fig. 13. Machines with Tilting Work-arbors that are Used for Marking the Size and Other Information on the Base End of the Cartridge Cases

left, to permit loading the work within the limited space available beneath the stamping head. The arbor and work are then swung into an upright position, as seen in the view of the machine at the right, after which the operator pulls down a lever, causing the marking stamp to be rolled crosswise over the end of the cartridge case.

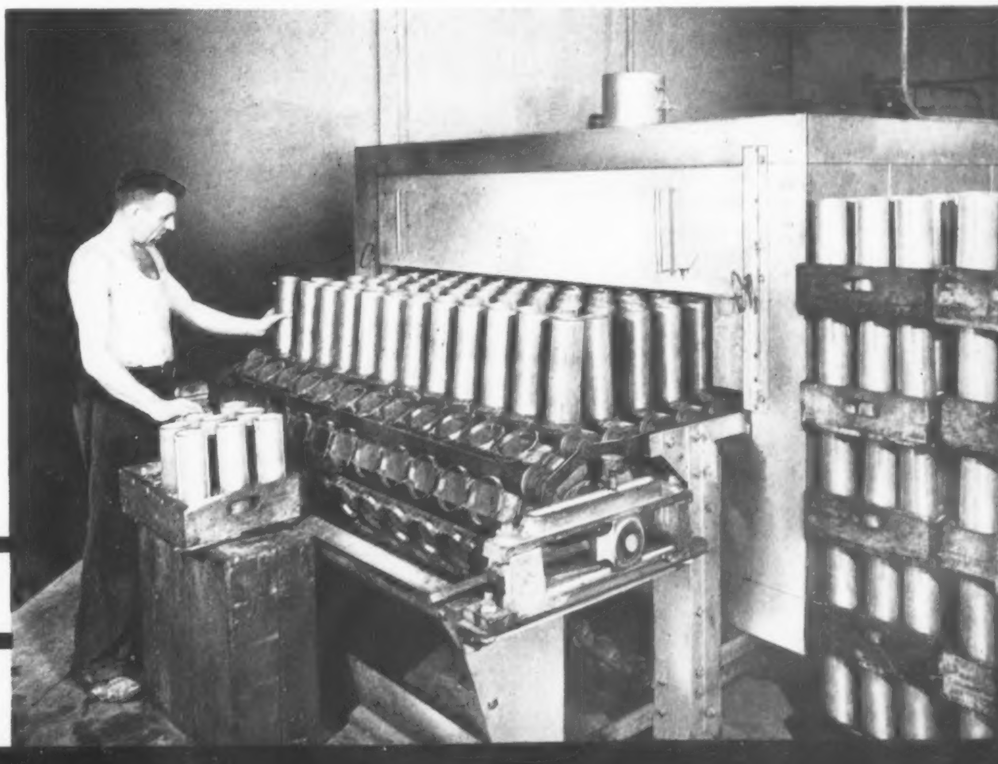
After being marked, the cartridge cases are placed in small boxes and rolled on a gravity conveyor through a wall into an adjoining room where the cases are placed on racks and dipped into a caustic bath for removing all grease. The cartridge cases are then loaded on the conveyor of the electrically heated furnace shown in Fig. 14. In this furnace, the cartridge cases are subjected to a low-temperature anneal, the furnace being operated at about 500 degrees F. The cartridge cases are placed upright in rows of twelve within narrow rings that are welded to the flat conveyor bars. It takes seventy-five minutes for the cases to pass through the furnace to the discharging end.

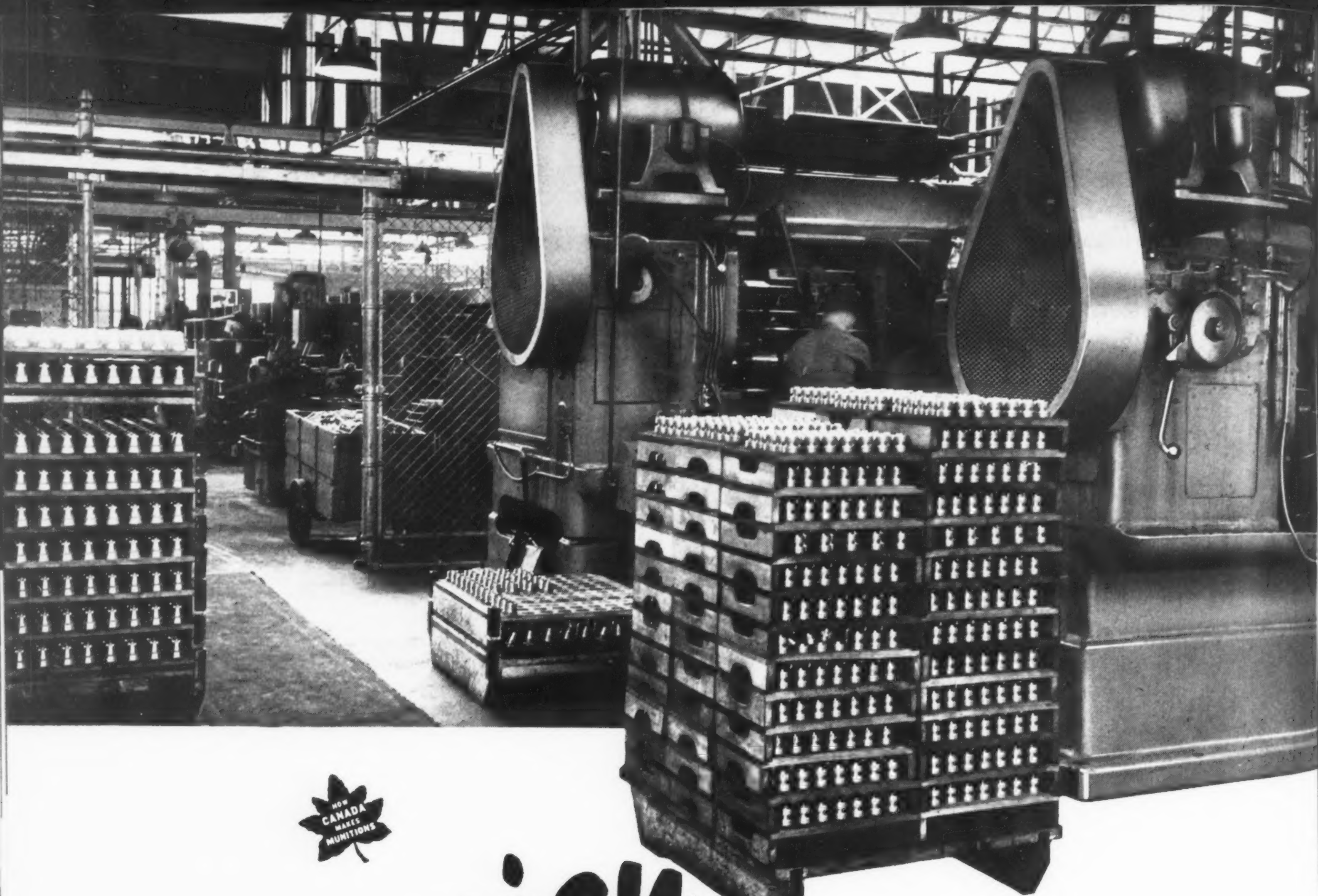
After the cartridge cases leave the furnace, they are pickled in a light solution of sulphuric acid and washed in water. They are then buffed with sand and sawdust to obtain a high polish and to dry the inside and outside surfaces thoroughly.

The final step in the production of the cartridge cases is complete visual and dimensional checking, first by shop inspectors and then by a corps of inspectors employed by the British Government. In this inspection, a Vickers Pyramid hardness tester is used on representative lots of the cartridge cases, it being the practice to take readings across the head of the cases and then along one side at points 1/2, 1, 1 1/2, 3, 4, and 6 inches from the base and at the mouth.

Production in the shop whose methods have been described is 35 per cent greater than the maximum believed obtainable when the press and machine set-ups were originally planned. At the time that the photographs here shown were taken, production was two months ahead of schedule.

Fig. 14. Loading End of the Low-anneal Furnace through which the Cartridge Cases are Passed after All the Machining Operations have been Completed





Percussion Fuses FOR 4.5-INCH HOWITZER SHELLS

MODERN automatics, with their high speed and advanced tooling, are proving especially advantageous in producing small munition parts. For example, in one Ontario plant devoted to the production of percussion fuses for 4.5-inch howitzer shells, fuse bodies are being produced by a machine of this type at the rate of 140 an hour, whereas the same parts, when made by using a number of machines of other types, were turned out at the rate of only five pieces an hour.

The automatic operation referred to is being performed on one of the Conomatics seen in the heading illustration. Close-up views of the tooling are presented in Figs. 1 and 2, while diagrammatic sketches are shown in Figs. 3 and 5. The machine is of the 2 5/8-inch size and of eight-spindle construction. Brass stock, 2 7/16 inches in diameter, is fed forward in the bottom station of this machine to a swinging stop, which is seen in its operating position in Figs. 1 and 2. After the stock has come in contact with the stop and been gripped by the collet chuck in which it is held, the stop swings down out of the way to permit a hole to be drilled in the end of the bar with a 1 9/16-inch drill on the main slide. The hole is drilled to a depth of 3/4 inch. At the same time, a single-point tool on a knee turner mounted on the main slide rough-turns the end of the bar.

In the second position, seen in the lower part of Fig. 1, a 1/2-inch hole is drilled to a depth of about

2 3/4 inches from the end of the bar, and the surface rough-turned in the preceding station is finish-turned to within 0.002 to 0.003 inch of the specified diameter by a tool mounted on a knee turner on the main slide. In this position also, a form tool on the front cross-slide rough-forms tapered and straight surfaces to produce the head of the fuse body, as seen at *B*, Fig. 3.

Then, in the third position, seen in the center of Fig. 1, a four-step counterbore machines the large hole in the end of the bar, as well as several other surfaces, as indicated at *C*, Fig. 3, and faces the end of the bar. At the same time, a form cutter on the front slide finish-forms a longer tapered surface and a shorter straight surface on the end rough-formed in the preceding station. While the cuts in the third station are being taken, the overhanging end of the bar stock is supported by rollers on the tool-holder mounted on the main slide.

The large-diameter hole in the end of the fuse body is threaded by a solid tap in the fourth station, which is held in an automatic attachment mounted on the main slide. An arm pivoted from a top member of the machine and actuated from the camshaft feeds the tap at a rapid rate to the work, and then at a slower rate for starting the thread, after which the tap feeds itself into the work. Both work and tap are revolved in the same direction while the threads are being cut, the tap, however, being revolved at a faster speed than the work. When the tap reaches the bottom of the hole its rotating speed is reduced to less than that of the work, so that the tap screws itself automatically out of the hole. While the tapping operation is in process, a form cutter on the front cross-slide takes a shaving cut on the tapered surface, as indicated at *D*, Fig. 3. The work is adequately supported during this shaving cut by an attachment on the main slide.

In the fifth position, at the top of the machine, a vertical slide is moved downward by a cam to bring a marking stamp against the work, which rolls the name of the firm, the size of shell for which the fuse is intended, and other information on the tapered surface. At the same time, circular recesses are cut at the bottom of the thread and in the small bore by an internal necking tool, as indicated at *E*, Fig. 5. The shoulder on the front end of the small bore is also faced by this tool, which is mounted on an auxiliary slide on the main slide. A sidewise feeding movement is imparted to the tools after they have been advanced into the work, so as to feed them to the required depth.

The work is next indexed into the sixth position, seen at the top of the machine in Fig. 2, where tools mounted on the rear cross-slide knurl two narrow widths on the tapered surface of the work, as indicated at *F*, Fig. 5. At the same time, a self-opening die-head on the main slide cuts an external thread on the cylindrical end of the fuse body.

In the seventh station, seen in the center of Fig. 2, a reamer on the main slide finishes the long blind hole in the body, while another tool on the main slide chamfers the outer end of the threaded hole, as shown at *G*, Fig. 5. At the same time, a "breakdown" tool on the rear cross-slide starts to cut off the piece. The cutting off is completed in the eighth station, as shown at *H*, by a tool on the rear cross-slide, the fuse bodies sliding down a chute, and into a receptacle in the pan of the ma-

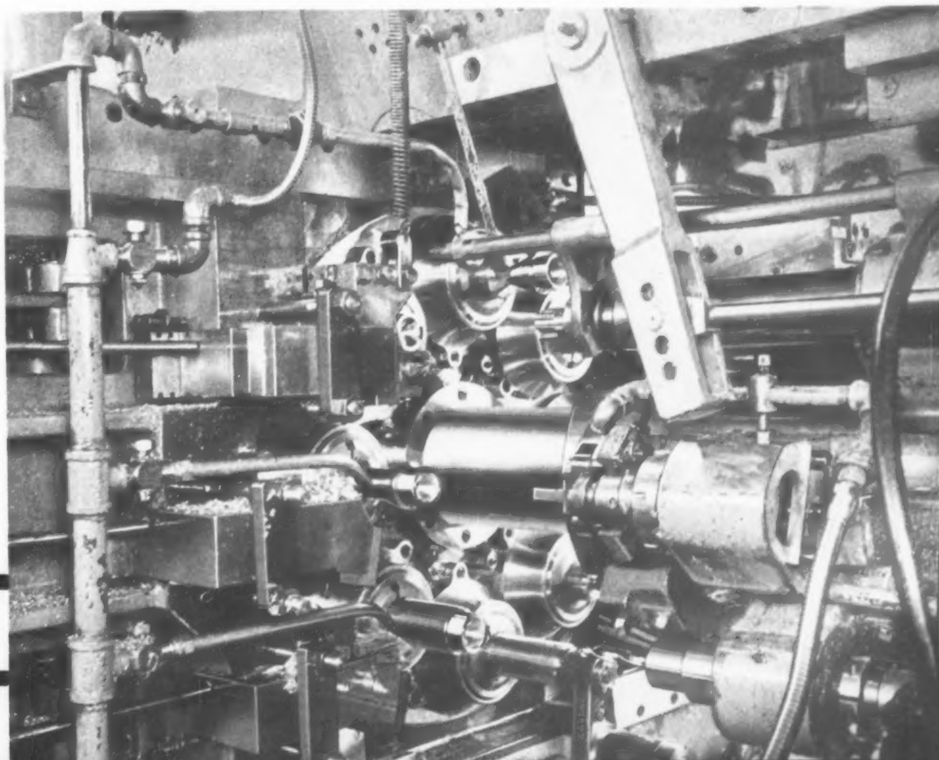


Fig. 1. Front View of a Conomatic Tooled up for Producing 4.5-inch Percussion Fuse Bodies

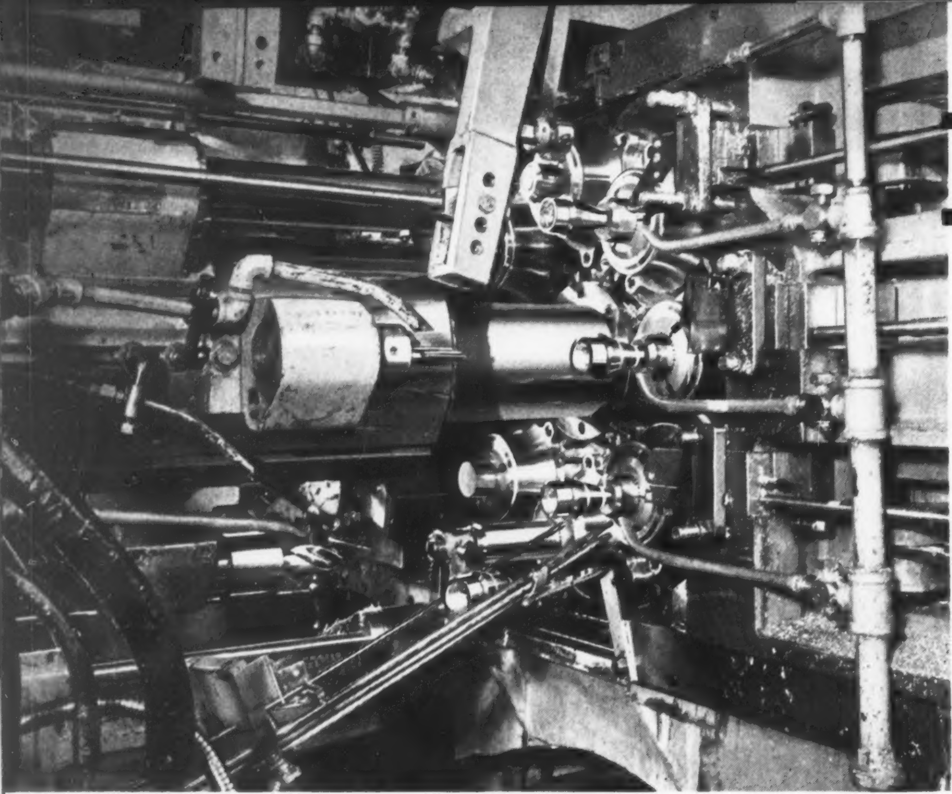
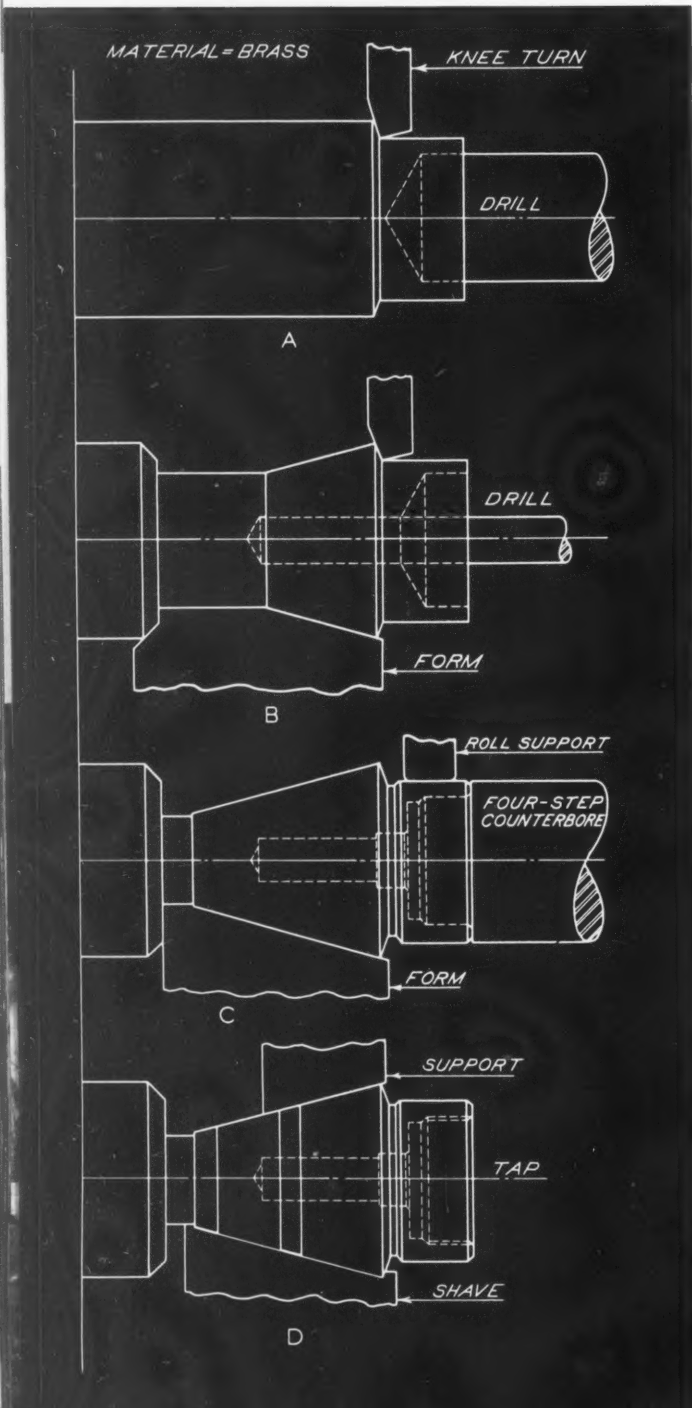


Fig. 2. Opposite Side of the Conomatic, Showing Chute down which the Finished Pieces Slide



chine. The chips, which accumulate rapidly, are removed from the pan by a conveyor.

The Conomatic seen in the right foreground in the heading illustration is used for producing both magazines and bottom caps from brass stock. It is the practice to change over the tooling for performing these two jobs approximately every week.

Another outstanding high-production machine used in this shop is the Acme-Gridley six-spindle automatic shown in Fig. 4, which is tooled up for the production of striker pins, such as seen on the top of the cross-slide. These parts are manufactured from 9/16-inch diameter bar steel that is approximately the equivalent of S A E 1015. When the pieces leave the machine, the long slender end has been turned down to a diameter of 0.100 inch, which indicates the large amount of stock removed by the machine.

In operation, the bar stock is fed forward to a stop in the lower rear position of the machine, as in conventional practice. In the bottom front position, seen in Fig. 4, to which the work is next indexed, a turning tool on the main slide machines a tapered surface at the front end, there being a small-diameter projection, about 1/4 inch long, in the center of the stock left after cutting off the previous piece. With the stock in the same indexed position, a form cutter on the side slide turns the stock for a considerable width along the back half

Fig. 3. Diagrams Showing the Tooling Provided in the First Four Stations of the Conomatic that Turns Out the Fuse Bodies

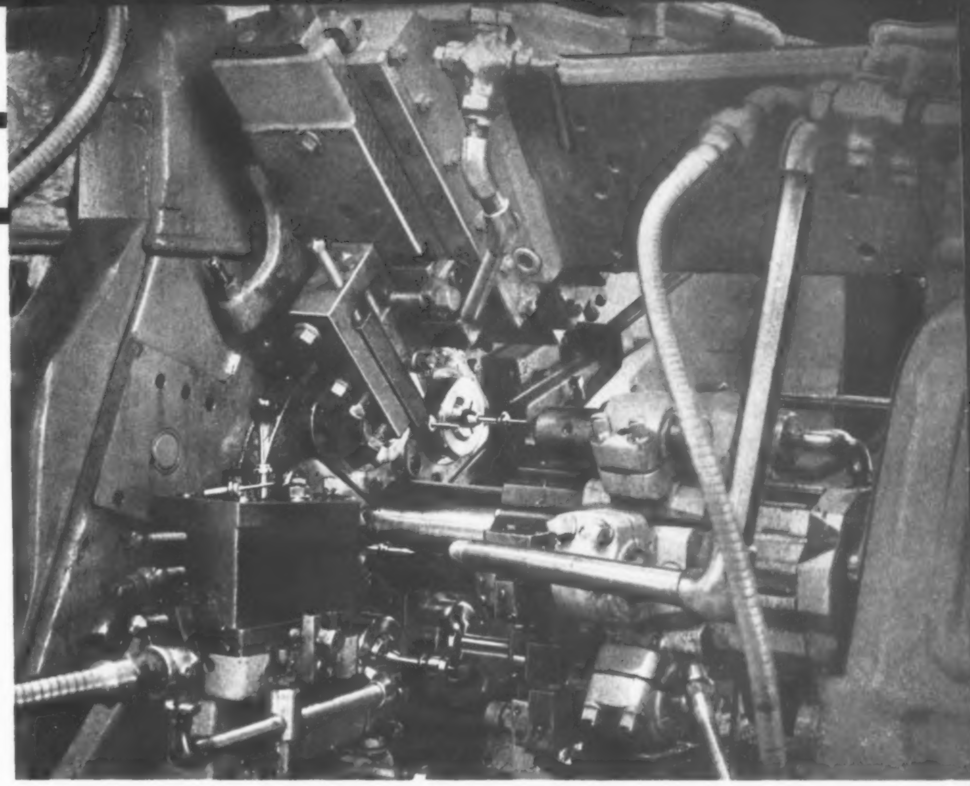


Fig. 4. Six-spindle Automatic which Produces Long Slender Striker Pins from Steel Bar Stock

of the piece, leaving a full-diameter head near the front end. The nature of this cut will be apparent from the appearance of the work in the second position of the machine in Fig. 4; this photograph was taken upon the completion of the cuts by the tools in the various stations and before the indexing of the spindle-carrier.

In the third position, seen in the center of Fig. 4, a roller-rest turner on the main slide cuts away the large head of the stock left near the front of the piece by the form tool in the preceding station. At the same time, a form tool on the side slide takes a finishing cut in back of the narrow full-diameter portion that remains near the middle of the piece.

From this point on, roller-rest turners are employed on the main slide for gradually machining the long slender spindle or needle on the front of the piece down to its final diameter. At the same time, tools on top slides at the front and back of the machine take turning cuts on the larger diameters near the middle of the piece. The finished striker pin is cut off by a tool opposite the sixth position on the rear side slide. Provision is made for deflecting the striker pins into a receptacle as they are cut off, instead of permitting them to fall into the pan and getting mixed with chips.

There are an impressive number of automatics in this shop of various types and sizes. In Fig. 6 is shown one of a battery of Brown & Sharpe auto-

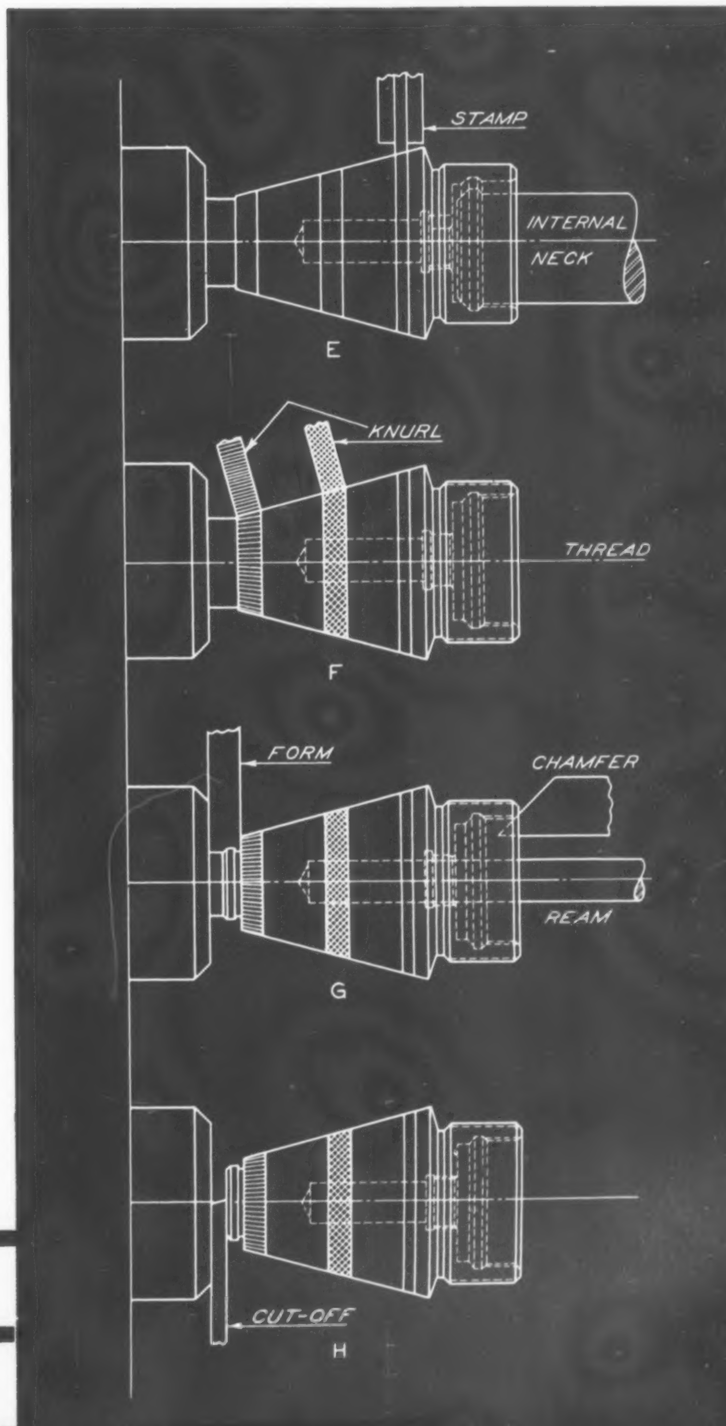


Fig. 5. Diagrams Showing the Tooling Provided in the Fifth, Sixth, Seventh, and Eighth Stations of the Conomatic

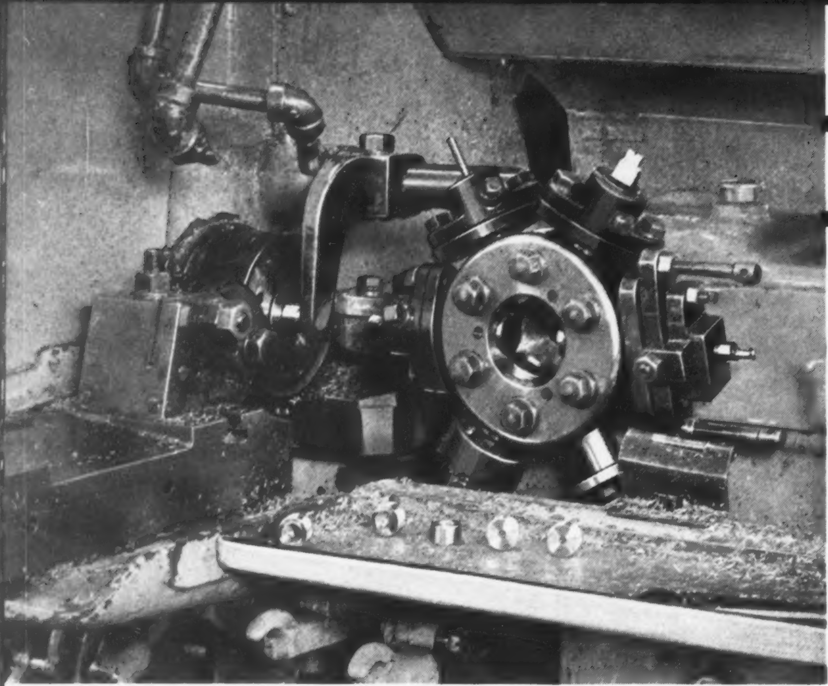


Fig. 6. One of a Battery of Brown & Sharpe Automatics, which is Equipped for Producing Detonator Holders from Brass Bar Stock

matics, the particular machine illustrated being used for producing detonator holders from 3/4-inch diameter brass bars. Finished pieces are seen lying on the tray at the front of the machine.

In this operation, a drill on the turret first drills a small-diameter hole in the end of the bar to a depth slightly greater than the length of the finished part. The next tool on the turret then counterbores the hole to almost the full depth of the finished piece. The third station of the turret is equipped with a tool mounted on a slide that is fed sidewise after the tool has been fed into the counterbored hole, for under-cutting a recess at the inner end of the counterbore. The fourth turret tool is an H & G self-opening die-head, which threads the end of the bar for a length equivalent to that of the finished piece. The fifth turret tool is a solid tap that cuts threads in the counterbored hole.

Next, the cross-slide is fed toward the rear to bring a form tool at the front of the cross-slide into contact with the work for chamfering the front end, and to start cutting off the bar stock to a vee, so as to produce a chamfer at the back end of the piece also. The cross-slide is then fed forward to bring into action a cutting-off tool mounted at the rear of the cross-slide. In Fig. 6, the swinging stop that controls the advance of the stock is shown in the downward position, ready for starting the production of a new piece.

There are, of course, many other types of machine tools in this plant besides automatics. In Fig. 7 is shown a Canadian Buffalo sensitive drilling machine equipped with a tool fixture of unique design for drilling a hole 0.150 inch in diameter almost the full length of the striker pins from the end opposite the needle point. The bottom of the hole must be the specified distance from the needle point within 0.005 inch—an exacting requirement, in view of the fact that the hole must be measured from the opposite end of the piece. The hole is approximately 1 inch deep.

The operation of this machine differs from the usual practice in that the work pieces are inserted one at a time in a Wahlstrom chuck held on the machine spindle. The three-position fixture on the machine table is provided with three stationary drills that are held vertically in line with guide bushings in overhead bars. The bushing bars are supported on springs, which are pushed down when the nose of the chuck comes in contact with the bushing to feed the work through the bushing and down over the drill. The rotating chuck is made with a small tapered nose that engages a conical seat on the guide bushings and causes them to revolve with the work.

With the first station of this fixture beneath the machine spindle, the small-diameter hole is drilled

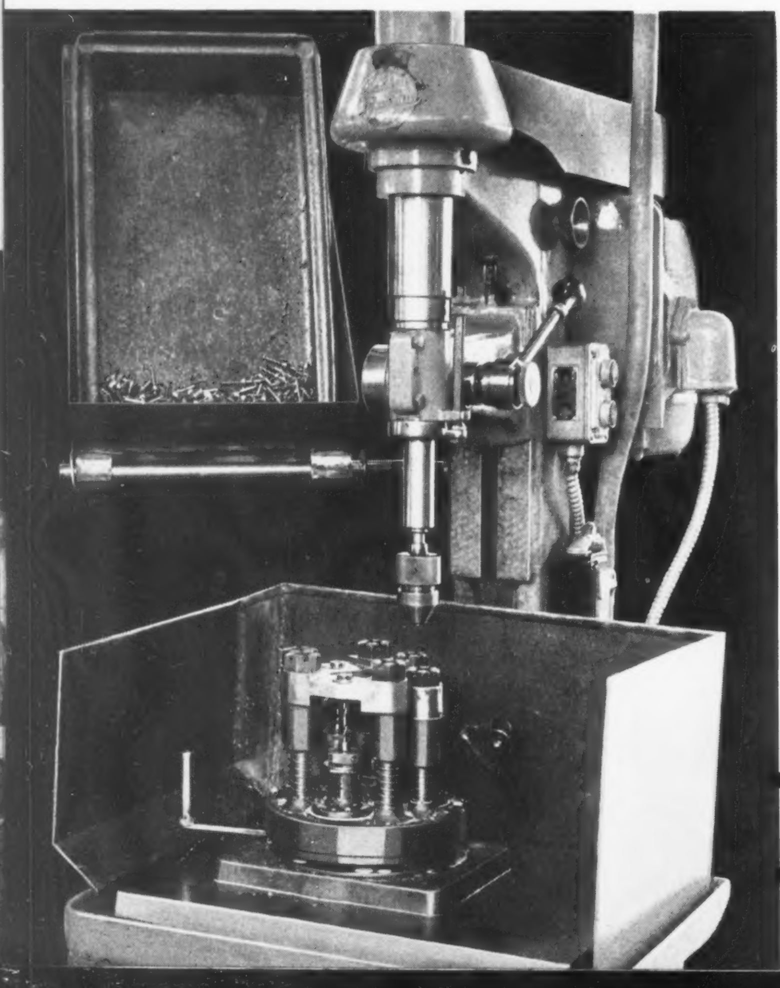


Fig. 7. Ingenious Fixture Provided on a Sensitive Drilling Machine for "Gun Drilling" a Small-diameter Hole in Striker Pins

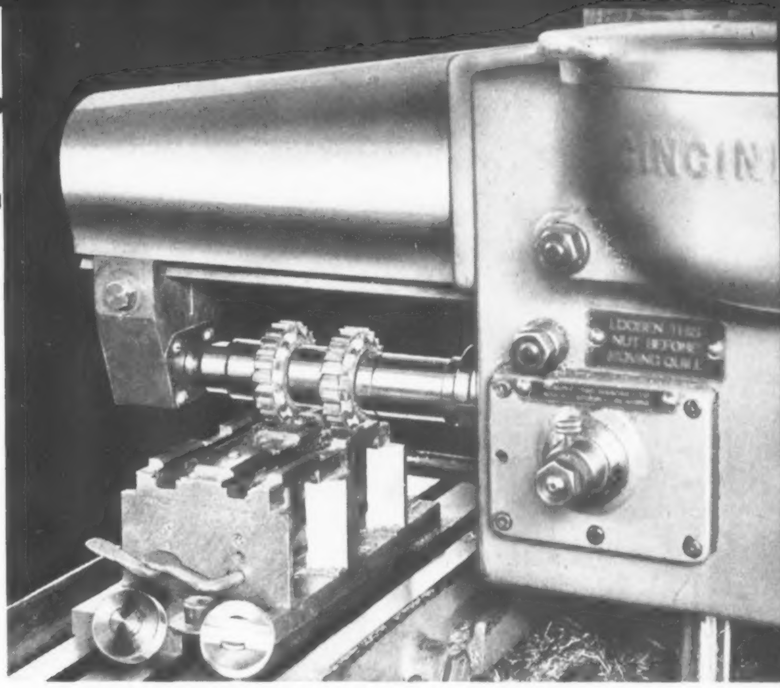


Fig. 8. Milling and Chamfering a Slot in One Side of Magazines within a Close Tolerance Relative to a Chamber in the Other Side

to one-half its depth in the striker pin. The hole is then drilled to its full depth in the second station of the fixture. In the third station, the upper end of the hole is counterbored.

Fig. 8 shows a Cincinnati No. 0 milling machine with a hydraulic table feed, which is used for milling a slot for the shutter slide across the end of magazines. This slot is cut almost the complete width of a boss on the closed end of the part, only a narrow wall being left on the opposite sides of the slot. The depth of the slot is of utmost importance, because the thickness between the bottom of the slot and the chamber in the opposite side of the piece must be held within 0.025 to 0.030 inch. Later a fine cut is taken on a drilling machine to reduce the thickness of this "diaphragm" to between 0.008 and 0.012 inch. At the front of the milling machine may be seen two of the magazines before and after the slot milling operation.

The magazines come to this machine direct from the Conomatic seen in the foreground of the heading illustration. The parts are loaded four at a time in the fixture of the milling machine, with the side in which the slot is to be cut held at two points against locating surfaces on a top member of the fixture. The pieces are slipped sidewise into the fixture under this top member, and are then raised into contact with the locating surface by handles at one end of the fixture, which actuate eccentrics beneath the blocks on which the parts rest.

Six cutters are mounted on the arbor of the machine for cutting a groove in the four work pieces with one table movement. The cutters are arranged in two groups, each consisting of a plain milling cutter in the center which machines the groove to its full width and depth, and an angular cutter on each side for beveling the top edges of the groove.

In Fig. 10 is shown a Kent Owens machine employed for slab-milling the top of light brass bars of rectangular cross-section, and cutting off the milled pieces in a second step to produce parts such as seen in the lower right-hand corner of the illustration. The bars are 1/4 by 3/4 inch in cross-section, and are fed to the cutters four at a time, being held between guides on a long table at right angles to the cutters. Two shoes on an equalizing clamp are brought firmly down on the pieces adjacent to the milling cutters by turning a handle.

When the work pieces are fed to the cutters, the plain cutter seen at the right cuts a groove 3/4 inch wide to a depth of 1/16 inch across the four pieces. At the same time, a thin saw, about 3/8 inch to the left of this cutter, cuts off the section of the bars milled in the preceding step. Thus, when an operation has once been started, four pieces are obtained with each traverse of the table past the cutters. At the end of the cut, the clamp is raised to release the

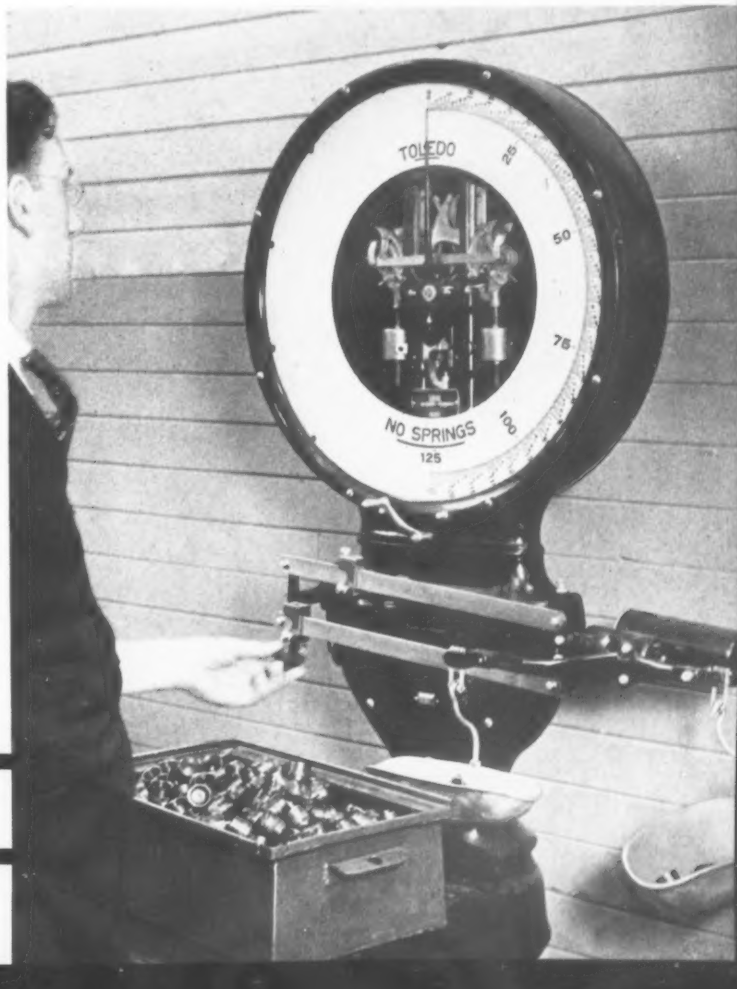


Fig. 9. Determining the Number of Work Pieces in a Tote Box by the Use of a Toledo Counting Scale

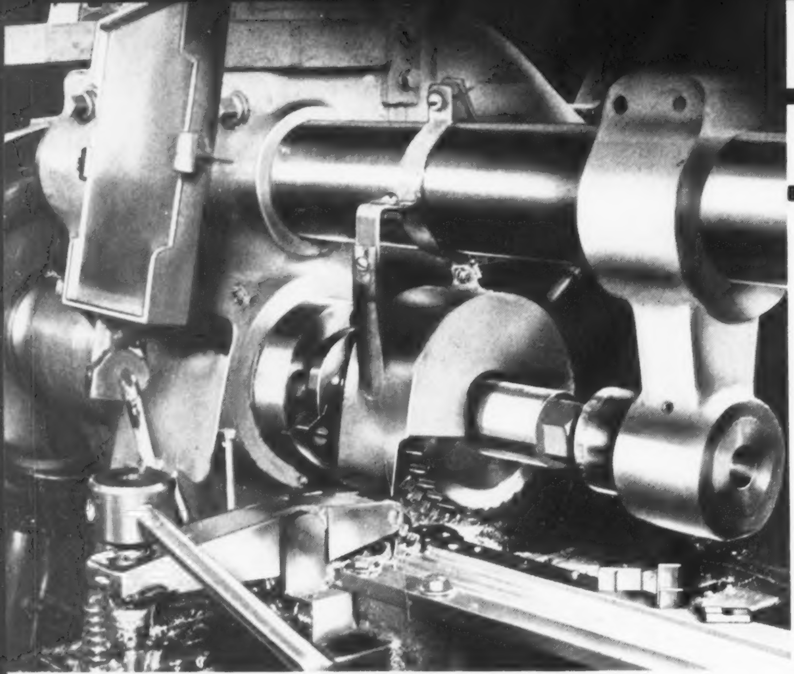


Fig. 10. Milling Machine Equipped for Slab-milling and Cutting off Small Pieces from Rectangular Brass Stock

bars of stock so that they can be advanced against the end stop, ready for the next operation.

In the manufacture of fuse parts in this shop, there is a gage for checking every dimension on each part. On the fuse bodies an inspection follows each operation, as this part is too expensive to run the chance of performing operations on defective pieces. Many of these gages are of the usual snap, ring, and indicator types, and are used singly, but in several instances, gages are assembled on plates, as illustrated in Fig. 11, for the progressive and rapid checking of a large number of dimensions on one part. The plate illustrated is equipped with five Federal dial gages at the left and six snap gages at the right for checking the magazines.

The inspector first places a magazine on a small stand in the center of the group of dial gages, with four pins that project from the magazine resting on four small plungers in the stand. These plungers are depressed by the magazine an amount depending upon the length of the magazine pins, and in moving down, they come in contact with the ends of long levers, which also bear against the indicator spindles; thus readings are obtained on the dials that indicate whether the lengths of the magazine pins are within specified limits. In this way, all four magazine pins are checked at one time.

The magazine is next placed on a stand in front of the fifth dial gage, which is provided with a plunger for determining the depth of the slot in the magazine from the top of the thin side walls left in machining the slot in the boss. Allowable variations are indicated in red around the dial gages for the convenience of the inspector. The snap gages are provided with "Go" and "No Go" surfaces for checking various diameters and heights.

A checking fixture of unusual type used on the completely assembled magazine is illustrated in Fig. 12. When a shell on which one of these fuses is mounted is fired from a gun, a shutter on the back of the magazine must slide sidewise in order to permit the striker pin to function when the projectile hits an object. The magazines are provided with a spring action that normally holds the shutter in the closed position, but is overcome by centrifugal force when the shell attains a certain speed in being discharged. The fixture illustrated is employed to determine whether the shutter will open at the specified speed. For this inspection, the magazine is screwed into a socket on the spindle of the checking fixture, and is revolved at various speeds, which are shown by the indicator. With the shutter on the side of the magazine toward the inspector, she can readily observe whether it functions properly or not. This inspection is conducted in the government inspection room where all parts are given a final check and the fuses are assembled.

The production of the various machines in this

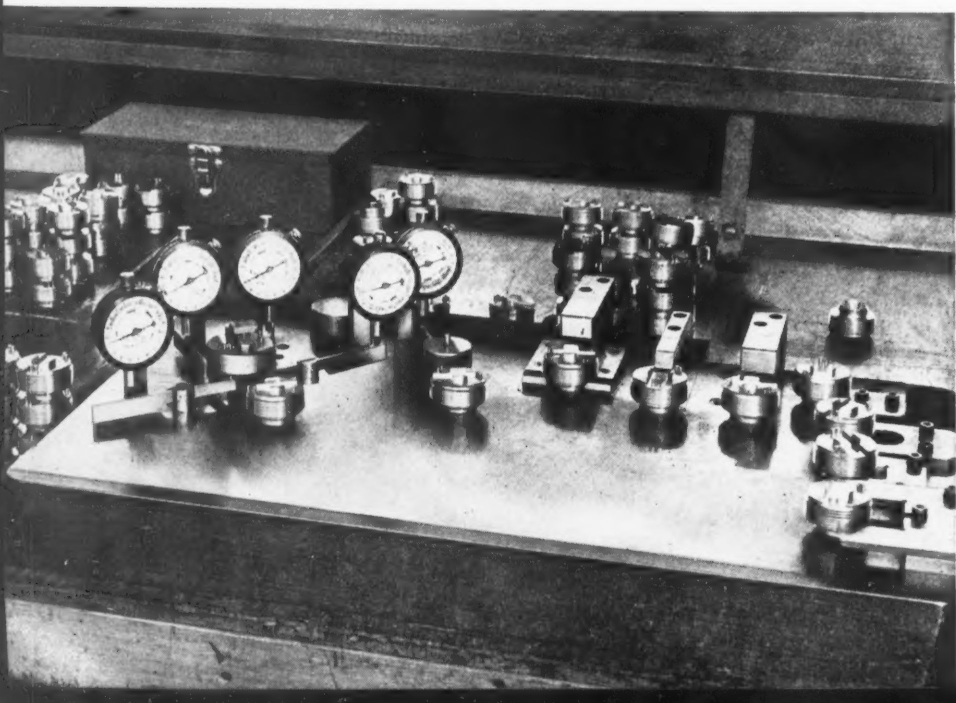


Fig. 11. Group of Gages Mounted on One Plate for the Rapid, Progressive Inspection of Magazine Dimensions

Fig. 12. Determining the Speed at which the Shutter Slide on a Magazine will Operate when the Shell is Discharged from a Gun

plant is readily determined by means of the Toledo counting scale shown in Fig. 9. When a tote box of the parts to be counted is placed on the scale platform, the weight of the parts is indicated by the scale pointer, a poise on the tare beam having been previously set to compensate for the weight of the tote box when empty. Parts from the box are then placed one at a time into the weighing pan at the right, and as this is done the scale pointer gradually moves toward zero. The addition of each part to this pan has the same effect on the pointer as the removal of 100 pieces from the tote box. When the pointer is almost to the zero mark, the inspector knows that the number of pieces in the "99 to 1" ratio pan are indicative within 100 pieces of the quantity originally in the tote box. Parts are then placed in the left-hand or "9 to 1" ratio pan until the scale pointer registers zero. By multiplying the number of pieces in the right-hand pan by 100, and the number of pieces in the left-hand pan by ten and adding the two products, the sum of the parts in the tote box and in the pans is determined.

Various fuse parts must be coated with lacquer as a protection against discoloration, corrosion, etc. In Fig. 13, is shown an automatic spraying and drying machine used for spraying lacquer on these parts. This machine is provided with a link-chain conveyor that moves on a square track around the machine. Fixtures are provided on the conveyor sections to hold the work pieces. In the particular operation illustrated, there are threaded posts on which small bottom caps are screwed. Loading and unloading occur along the conveyor track on the side of the spray booth opposite that seen in the illustration.

From the loading station the work pieces pass through an electrically heated oven that is maintained at a temperature of 180 degrees F. to prepare the parts for spraying. As the pieces leave this oven they are carried in front of a Paasche spray gun, which is arranged to oscillate through an arc of about 15 degrees, so as to direct the lacquer continuously on each piece as it passes through the arc. At this point the work is revolved, so as to present all surfaces toward the spray gun.

From the spraying compartment the work pieces turn a corner and pass under a battery of eight infra-red lamps which thoroughly dry the lacquer, the parts also being rotated as they move beneath the lamps. In the case of the bottom caps being handled in the example illustrated, the work pieces are carried around the machine twice for lacquering both sides. The machine is operated at a speed suitable for lacquering over 1000 pieces an hour.

The fuse plant to which this article refers was completely set up in 3 1/2 months with a manufacturing floor space of 11,000 square feet, and has been subsequently considerably enlarged.

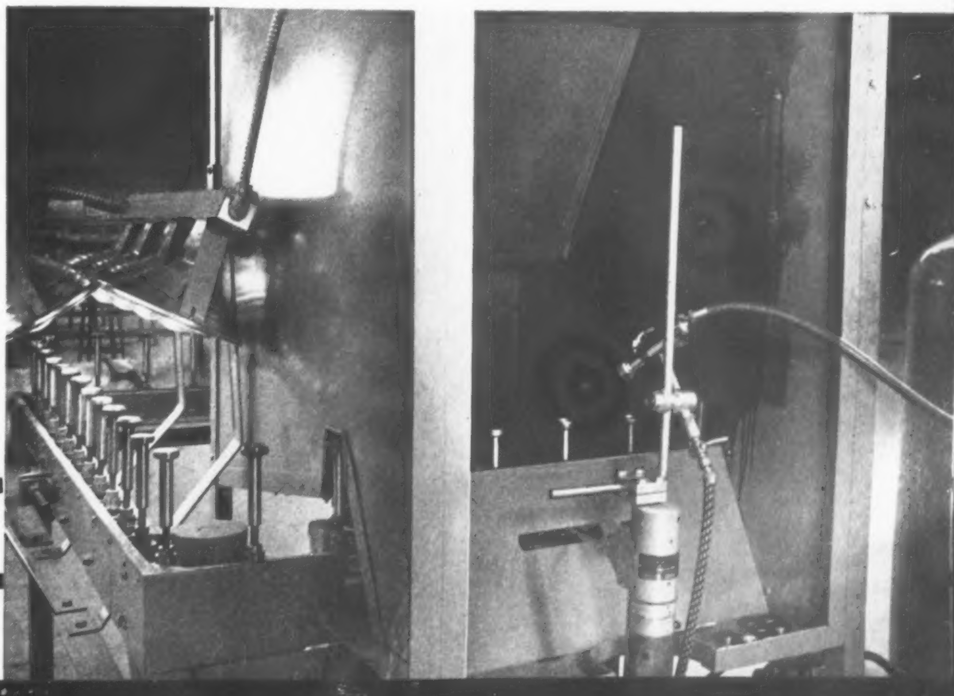


Fig. 13. Special Automatic Machine Designed for the Heating, Lacquer-spraying, and Drying of Various Fuse Parts

HOW CANADA MAKES MUNITIONS

Canadian Methods

More Than 2800 Machining Operations and 6000 Different Types of Gages are Required for the Manufacture of the Bren Gun which Fires at the Rate of 550 Rounds of Ammunition per Minute
First of Two Installments

THE machine guns in general use by the British, French, and German Armies in the early days of the first World War weighed 50 pounds or more. When these guns were used in more or less fixed positions, as in trench warfare, their weight was not a serious objection, but it proved to be a considerable handicap when troops were called upon to make advances in the face of enemy fire. The Lewis machine gun, developed to supplement the Vickers, which was used up to that time by the British forces, was fired from the shoulder while supported on a low bipod rest, was air-cooled, and weighed about 30 pounds. This machine gun was, therefore, capable of being used beside rifles in open warfare and was, to some extent, substituted for rifles, but its weight still caused fatigue of the soldiers when it was necessary to carry it very far by hand.

After the World War, lighter machine guns were developed in various countries. Most of these guns had similar characteristics, and weighed around only 20 pounds. They were operated by gases emanating from the exploded cartridges, were fed from magazines capable of holding twenty to thirty rounds of ammunition, were air-cooled, and were fitted with some type of quick changeable barrel. From these various machine guns, the British War Office selected a Czechoslovakian product as the best, and this gun, with certain modifications, is now the standard light machine gun of all British armies. It is known as the Bren gun, a term derived from the name of the town in which it was developed, Brno, and from the name of the town, Enfield, that is the home of the Royal Small Arms Factory in England.

The Bren gun weighs 21 pounds, and utilizes gas from the exploded cartridge to operate the breech mechanism. The gas passes from the barrel through a port that is uncovered by the bullet in its travel through the barrel, the function of the bullet being in the nature of a piston valve.

From the uncovered port the gas is directed through a regulator into a cylinder where it impinges on the head of a small piston. As the piston is driven toward the butt end of the gun, an exten-

OF PRODUCING THE BREN LIGHT MACHINE GUN

sion of the piston operates the breech mechanism to eject the fired cartridge. The piston is returned to its starting position through spring action when the gas has been exhausted and a new cartridge has been slipped into the barrel chamber. The normal rate of firing is about 550 shots a minute. However, as the cartridge magazine must be replaced after every thirty shots, the average rate of firing is about 200 times per minute.

The Bren gun comprises 163 different parts, which must be machined to dimensional tolerances that average 0.002 inch. On certain parts the tolerances are as close as 0.0003 inch. These requirements presented many difficulties in establishing a plant in southeastern Ontario for the manufacture of Bren guns on a real production basis. Machine tools had to be purchased and equipped with tools and fixtures for the performance of over 2800 machining operations. Six thousand different types of gages had to be designed; 12,000 are actually in use by the machine operators and inspectors. There is a gage for every single dimension on the gun and, in addition, there are many gages for detecting cumulative errors.

As, obviously, it would not be feasible to describe every operation in such an immense manufacturing program here, this article will be confined to operations performed in producing some of the more important parts. The examples presented indicate the types of machine tools selected as best fitted for the various jobs.

An outstanding characteristic in machining the various parts for the Bren gun is the great amount of stock that must be removed from the original forging to produce the finished piece. For instance, the forging for a gun body weighs 45 pounds, whereas after the performance of 269 operations, the finished body weighs only 5 1/2 pounds. Likewise, the bar from which the gun barrel is made weighs 10 pounds, and the finished barrel 6 pounds. The slide butt forging weighs 22 pounds, and the finished piece 3.7 pounds.

MAKING THE

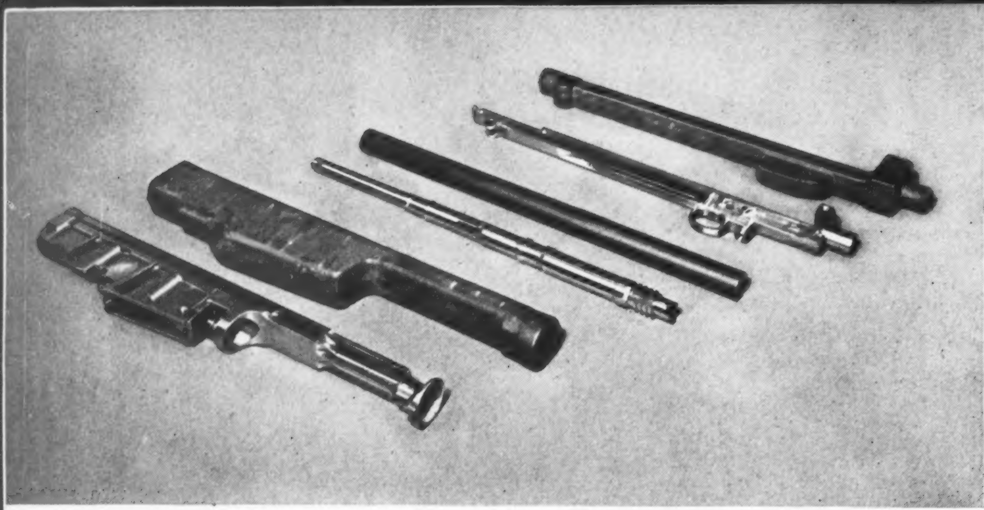


Fig. 1. Three of the Important Parts of a Bren Machine Gun, together with Forgings Similar to Those from which the Parts were Produced

It is interesting to note, in Fig. 1, the difference between the appearance of the finished parts and the forgings from which they are machined. The finished body and its forging is seen at the left in this illustration, the finished barrel and a piece of barrel stock in the center, and the finished slide butt and a rough forging at the right. Forgings and other steel pieces weighing a total of 101 pounds are required to produce the finished steel pieces for the Bren gun, which weigh only 18 pounds.

All forgings are heat-treated to a specified Brinell hardness before any machining is started. Hardness readings are obtained by means of the Pyro-Electro machine illustrated in Fig. 2, which is designed to apply a force up to 4500 kilograms on a ram 5 1/2 inches in diameter.

After some preliminary operations on the gun body, this part is ground flat on both sides within a total tolerance of 0.0018 inch on a Hanchett surface grinder, as illustrated in Fig. 4. The body is ground the full length of approximately 24 inches, except for a distance of about 1/2 inch on the end overhanging the magnetic chuck, which must be left round. Two parts are ground simultaneously. The table is reciprocated hydraulically, the stroke being controlled by stops that actuate hydraulic valves.

In Fig. 3 is shown a Gisholt turret lathe located in the gun body production line, which is equipped with a fixture in front of the headstock in which the work piece is accurately located and revolved off center with respect to the main length of the part. The first cut taken on the turret lathe consists of drilling a hole 0.480 inch in diameter within plus 0.001 inch, minus nothing, for a depth of approximately 3 3/4 inches, the tool being mounted on the turret. The next turret face is equipped with a tool for drilling the same hole to a diameter of 0.875 inch for a depth of about 2 3/4 inches. The third turret face is provided with a tool for boring this hole to 0.890 inch in diameter, while a reamer on the next face of the turret finishes the hole to 0.898 inch, within plus or minus 0.002 inch.

On the fifth face of the turret there is a tool that counterbores the front end of the hole in the gun body to a diameter of 1.250 inches, within plus or minus 0.005 inch, for a depth of 0.880 inch. Another tool on the sixth turret face enlarges the counterbore to 1.263 inches, within plus or minus 0.002 inch.

Fig. 2. Every Forging for Bren Machine Guns is Checked for Hardness on a Machine of the Type Here Shown

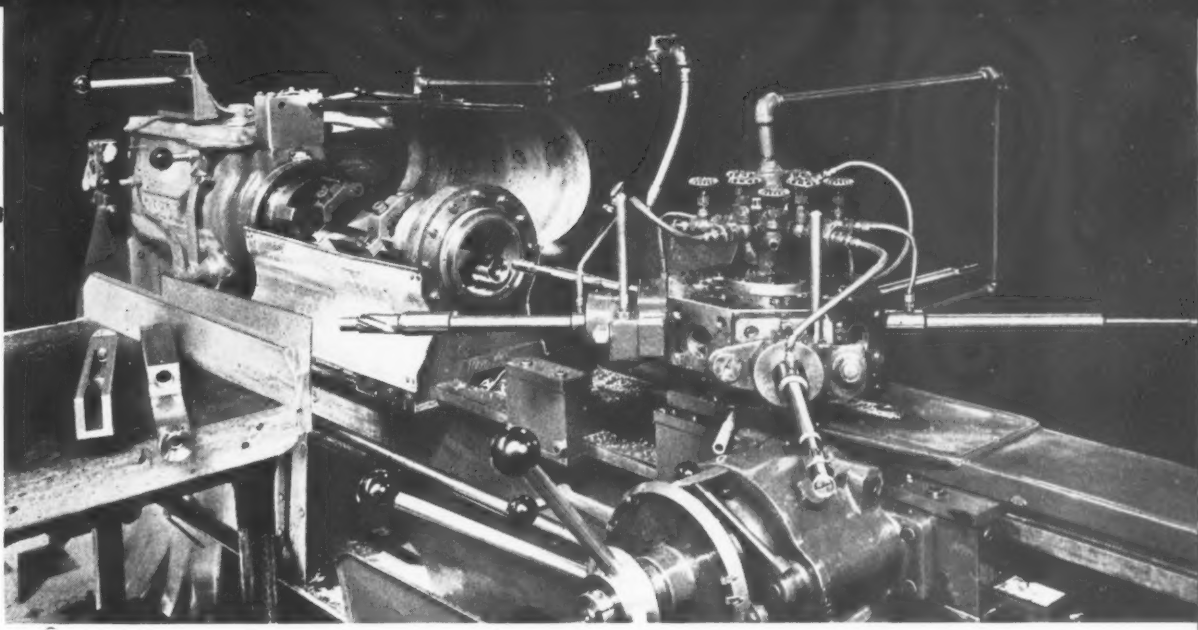


Fig. 3. Turret Lathe Used for Drilling and Reaming a Hole in the Gun Body to Unusually Close Tolerances

Extreme care must be taken in machining another hole in the end of the gun body to receive the piston, because this hole must be finished to 0.627 inch, within plus or minus 0.0015 inch, for a length of 5 inches. In addition, a counterbore at the end of the hole must be concentric within 0.0005 inch, and the center of the hole must be at a specified distance from one surface within 0.001 inch, and at a certain distance from another surface within plus or minus 0.0005 inch. This hole is rough- and finish-bored and also counterbored by the Heald two-spindle Bore-Matic illustrated in Fig. 5.

The work is supported on a table fixture which is indexed to the back of the machine, as illustrated, for the first step in the operation, which brings the hole to be bored into line with the rear spindle of the machine. The boring tool is mounted in a long slender bar that is guided in a bushing immediately in front of the work. The bushing is made with a slot to permit passage of the tool through it, in making a cut, as well as withdrawal at the end of the cut. The practice is to rough-bore a batch of gun bodies with the work fixture held in the rear position, after which the cutter is reset for finish-boring the same bodies.

Finish-boring is also performed with the work fixture in the rear position. When each gun body has been finish-bored, the table is automatically fed forward into line with the front cutter-spindle, which is employed for counterboring the end of the hole to three diameters. The counterbore is made with a small pilot that enters the finish-bored hole ahead of the cutting edges and guides them accurately in relation to the bored surface, thus insuring concentricity. The table movements are derived from a hydraulic cylinder. At the left-hand end of the machine in Fig. 5, are seen the gages used to inspect the work before it goes to the next machining operation.

There are a considerable number of machines in this plant designed for milling surfaces of irregular contours as the cutter moves around the work under the control of a cam. One of these machines, which was built by the Modern Tool Works, Toronto, Canada, is illustrated in Fig. 6. The particular operation shown consists of form-milling one end of a gun body around a true circle for 270 degrees, and cutting a slight relief toward the center of the part at each end of the circular portion.

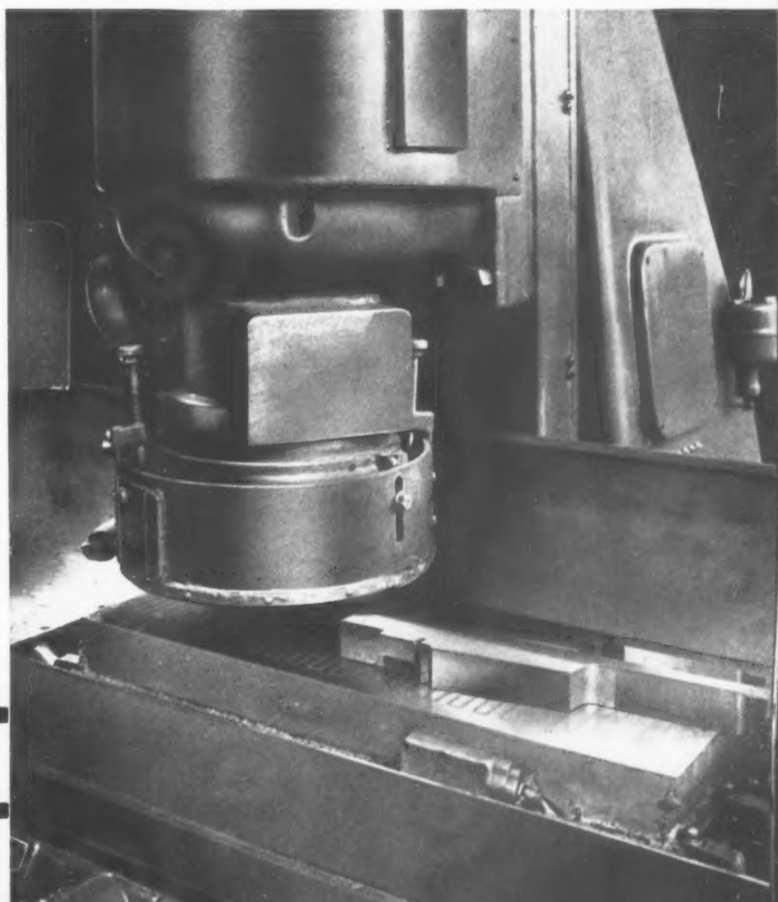
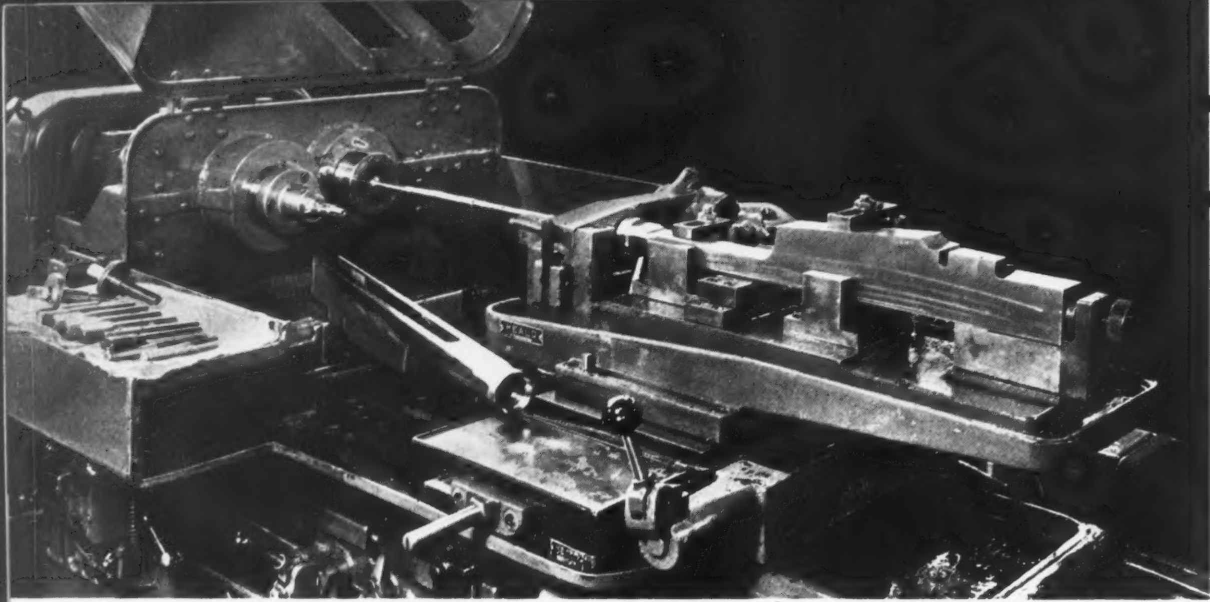


Fig. 4. One of the Preliminary Operations on the Gun Body Consists of Surface-grinding Both Sides



MAKING THE

Fig. 5. Bore-Matic Employed for Rough- and Finish-boring and Counterboring the Hole that Receives the Piston

This necessitates that the cutter be fed radially outward a slight amount after the cut has been started, and radially inward the same amount as the end of the cut is reached.

The cutter movements are derived from a cam of the required contour, which is mounted on the work-head and revolves with the work. Through the action of a hydraulic cylinder at the front of the machine, which exerts constant pressure against the table on which the work-head is mounted, this cam is held in contact with a roller mounted on a unit at the back of the machine. The same unit is provided with a bearing that supports the overhanging end of the cutter-spindle. Thus, as the changing contour of the cam revolves over the roller, the work-table slides forward and backward on the machine bed an amount corresponding to the rise and fall of the cam. The gun body is almost completely enclosed by the special work-head, into which it is inserted from the right-hand end. After the work has been gripped by the chuck jaws, an ingenious lever arrangement is operated to engage a worm drive for revolving the work.

Rise-and-fall milling machines are also used for a considerable number of operations. In Fig. 8, a Cincinnati milling machine operating on this principle is seen engaged in one of the preliminary operations on the slide butt. As will be apparent from the part lying at the front of the table, it is necessary for the cutter to be lowered for milling the surface that is seen finished, and raised at the end of the cut, in order to clear the lugs at the opposite ends of the pieces. When the operation is started, the spindle carrier is fed downward hydraulically at a rapid rate until it almost touches the work, and then fed at a slower rate to the actual cutting depth, which is controlled to within 0.0003 inch. The table is then fed horizontally, and just before the bosses on the right-hand end of the work are reached, the spindle carrier again moves upward. Right- and left-hand sides of the slide butts are milled. The table is also actuated hydraulically.

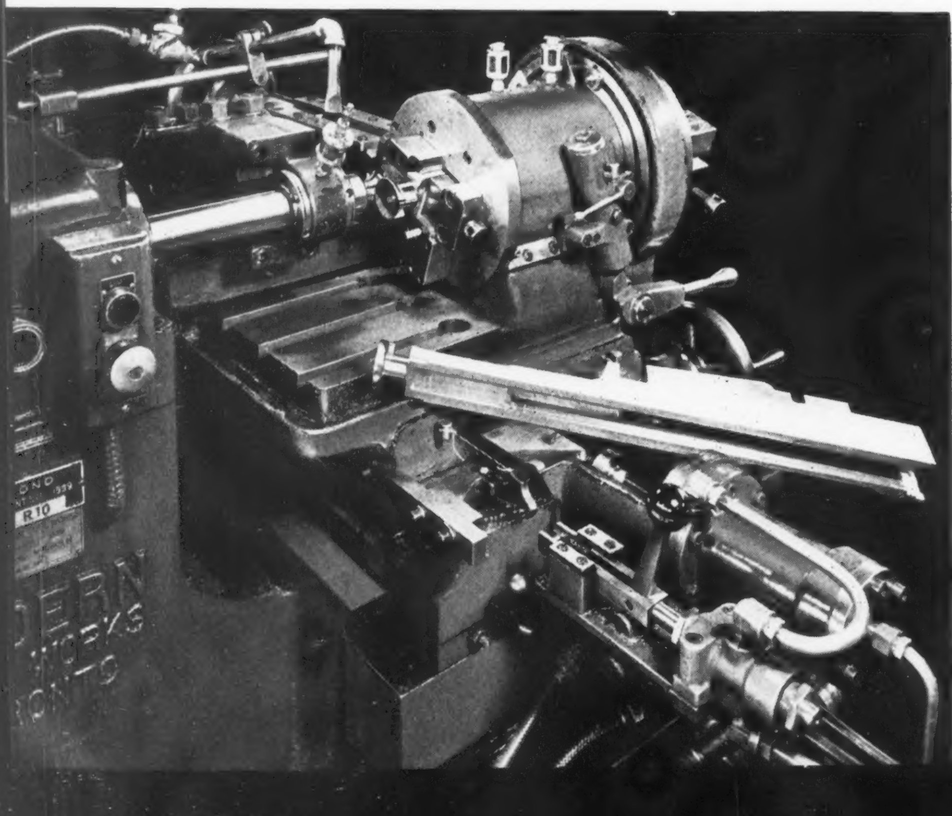


Fig. 6. One of a Number of Operations in which the Work is Moved in and out in Relation to the Cutter by a Cam Action, Both Cutter and Work Revolving

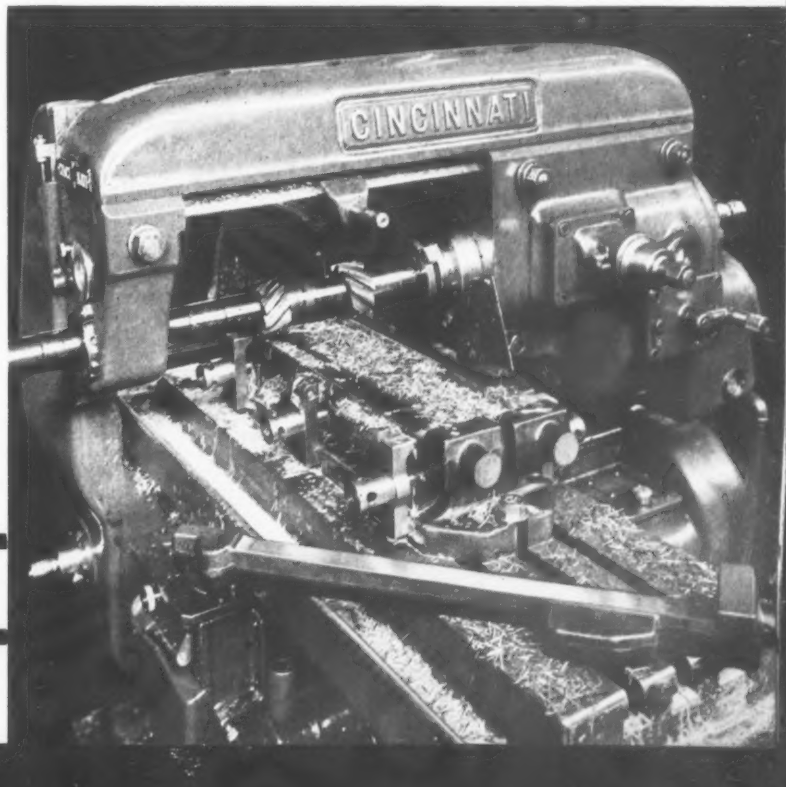
Fig. 7. Two Barrels are Drilled at a Time by a Single-lip Cutter through which Coolant is Supplied at High Pressure

In Fig. 9 is shown a Milwaukee vertical-spindle milling machine employed for cutting through webs of metal on opposite sides of one end of the slide butt with such exactness as to blend the surface produced by the face of the cutter with the previously milled surface that extends almost the full length of the piece. The nature of the cut will be apparent from the two examples at the front of the table. This slot is milled to specified width within 0.002 inch. The work piece is securely supported and located in a fixture by inserting the previously machined round extension on one end into a half bearing in the fixture, in back of the cutter, and also by clamping a long portion of the straight surface against a hardened and ground block in front of the cutter.

An elongated slot is milled through the solid stock of the piston extension by Taylor & Fenn double-end spline millers arranged as illustrated in Fig. 10. This slot, which is seen at the left-hand end of the work piece at the front of the cross-slide, must be milled to a width of approximately 0.500 inch, within 0.008 inch, for a length of nearly 3 inches completely through the piece, except for a thickness of about 1/32 inch on one side. Then, in a second operation, this thin wall is cut through for a length of about 1 11/16 inches. Both operations are performed on the same type of machine.

In the first operation, which is the one illustrated, the end-mills are fed into the work until there is a wall thickness of only 1/32 inch on the far side of the piece, after which the cross-slide is fed toward the rear of the machine under hydraulic pressure to cut the slot to the required length. Two pieces are machined at the same time by end-mills in the opposing spindles of the machine. One end of each piece is located from a hardened and ground block at the back of the fixture, against which the parts are forced by tightening adjusting screws against the front ends. The ends of the parts adjacent to the locating block are supported for a length of about 3 inches, and the parts also rest on

Fig. 8. Rise-and-fall Milling Machine Employed for an Operation in which the Cutters Must be Moved Vertically in Order to Clear Higher Surfaces at Both Ends of the Surface being Finished



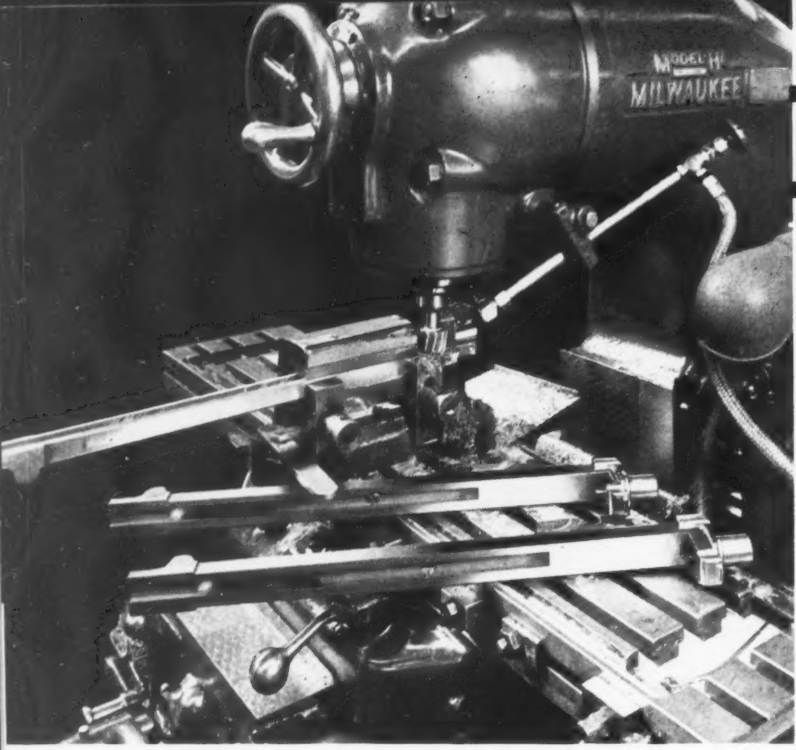


Fig. 9. Milling Two Webs from One End of the Slide Butt in a Set-up that Insures Blending of Two Finished Surfaces on the Work

machined lugs about 1 inch wide near the front end of the fixture. Except for the actual cutting, the second operation is identical with the first.

Pratt & Whitney gun drilling machines are used to drill the barrels, as shown in Fig. 7. At this point in the manufacturing procedure, the barrel has been rough-turned and is 22 1/2 inches long. Drilling is performed in the usual manner for this type of work, by employing a single-lip cutter to which coolant is fed under a pressure of 1000 pounds per square inch through a hole in the middle of the cutter bit and the bar to which the bit is attached. The coolant washes all chips down the drill flute from the cutting edges and through a groove in the drill bar to the outside of the gun barrel. The barrel is drilled to a diameter of 0.284 inch in this machine, two barrels being handled at a time.

Three draw-boring operations are then performed on the rifle bore in a machine designed to accommodate two barrels at a time, which are revolved by gearing, as in the case of the drilling machine. Two pull-heads draw five-fluted reamers through the barrels. The reamers are mounted on the end of hollow draw-bars through which coolant is pumped to the cutting edges of the tools. The first draw-bar enlarges the hole to a diameter of 0.293 inch within a tolerance of 0.003 inch; the second draw-bar increases the hole size to a diameter of 0.297 inch within 0.002 inch; and the third draw-bar increases the hole size to 0.299 inch within 0.001 inch. The draw-boring operations are not performed successively, the third draw bore being performed after the barrels have been finish-turned and any necessary straightening done.

Straightening is performed on presses of the design seen in the illustration on page 161. The inspector lays each barrel, as shown, on an anvil and sights the barrel through a window at the north sky. A black curtain with a straight horizontal lower edge shuts off the upper portion of the window. The position of the barrel on the anvil is such that the curtain edge casts a conical black shadow in the bore, extending half way through it. If the tapering lines of the shadow run straight to their meeting point, the barrel is straight, but if these lines are concave or convex, the inspector knows that the barrel is bent at the points where concavity or convexity occurs. Straightening of the barrel is accomplished by sliding the barrel along the anvil to the point where it is bent, and operating the large handwheel on the press to raise the barrel under considerable pressure against two upper jaws. When one end of the barrel has been straightened, the inspector checks and straightens the opposite end in the same manner.

The barrels are next "spill-bored" in an operation also performed on a two-spindle horizontal machine. For this operation, use is made of a tool machined to a square section and having two cutting edges. Thin laminations of wooden "spills"

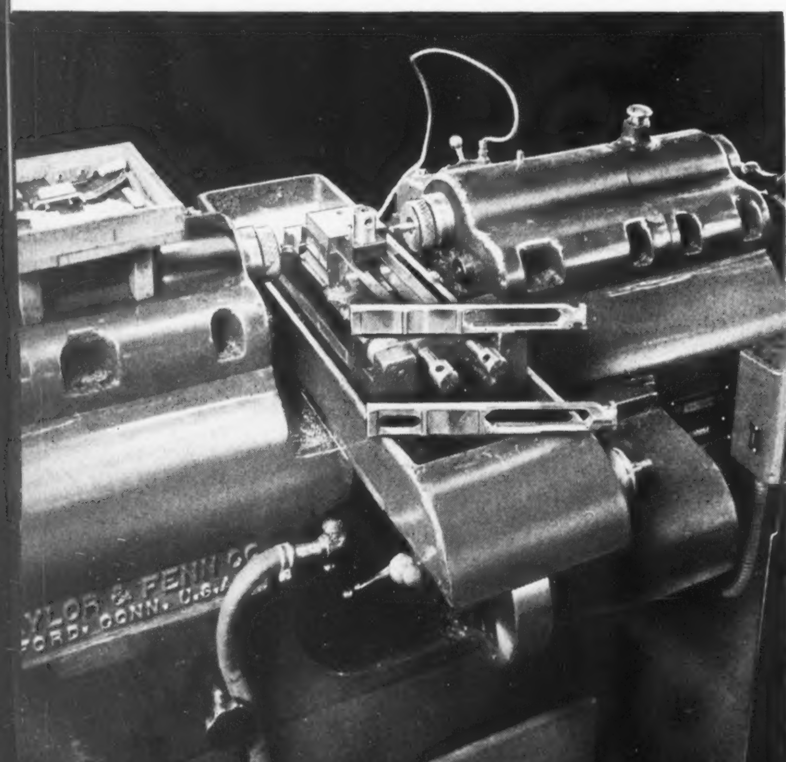


Fig. 10. Double-end Spline Miller Employed for Cutting a Slot through Solid Stock in Piston Extensions

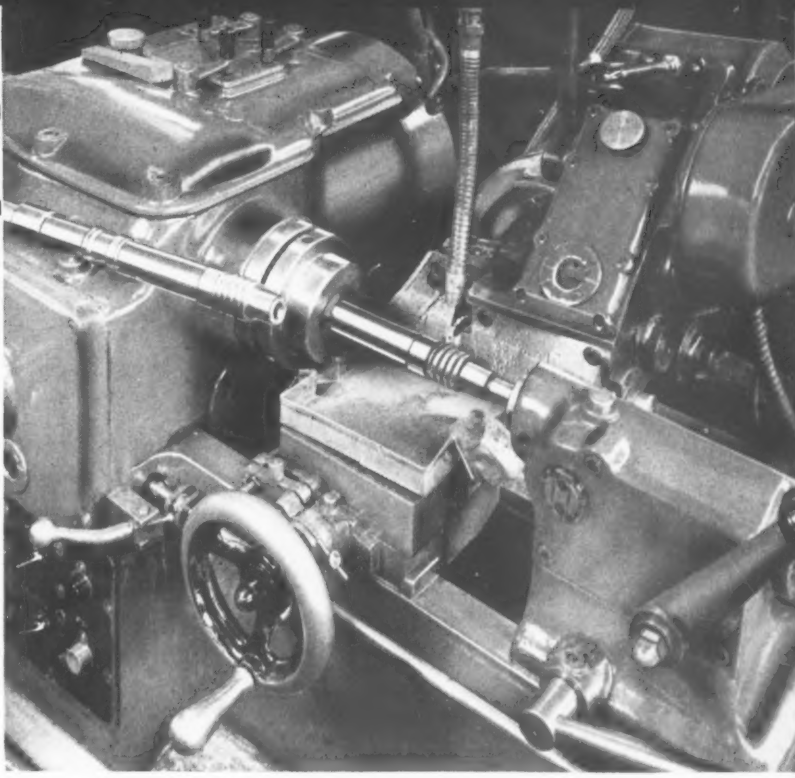


Fig. 11. The Threads on the Breech End of the Gun Barrel are Produced on a Thread Milling Machine Set up with a Cutter of the Single Type

are built up on opposite sides of the tool to force one of the cutting edges into engagement with the bore as the revolving tool is drawn backward through the barrel. To further increase the size of the bore, thicker wooden "spills" may be placed on the cutter or the previous "spills" may be backed with pieces of thin paper. It is generally necessary to take four or five cuts in bringing a rifle bore to the specified diameter of 0.301 inch within a tolerance of minus 0.0015 inch plus nothing. The work remains stationary in this operation, the tool being run at 140 R.P.M. and fed at the rate of 30 inches a minute.

Rifling is performed on Pratt & Whitney rifling machines of conventional design. Six spiral grooves are produced in this operation by a tool which cuts the successive grooves to a depth of about 0.001 inch at each stroke through the gun barrel. While the tool moves through the barrel, it is also swiveled to cut the grooves to the required helix. The barrel is indexed after every return of the tool to its starting position. When the tool has made six passes through the barrel, the tool bit is automatically fed outward 0.001 inch for the next six strokes. This cycle is repeated until the operation is finished.

Upon the completion of the rifling operation, threads are cut on the end of the barrel in the Pratt & Whitney thread milling machine shown in Fig. 11. The thread is left-hand, of square style, with slight fillets at the root, and of 0.2756 inch pitch. The diameter at the root is 1.114 inches within limits of minus 0.006 inch, plus nothing. The groove width is from 0.140 to 0.145 inch.

The barrels are next lapped four at a time in a machine of upright construction, as shown in Fig. 12. For this operation, lead laps are produced by inserting steel bars, about 1/8 inch smaller in diameter than the barrel bore, into the bore and pouring molten lead into the barrel. Thus a lap having a minimum thickness of 1/16 inch is produced all around one end of the steel bar, tape having been previously tied around the bar to prevent the lead from running completely down the barrel bore. The lead lap is about 3 inches long. After the lap has been cast, it is withdrawn with the steel bar from the barrel bore by a spiral pulling action. The flutes in the lap are then nicked to insure a tight fit in the barrel bore, after which an abrasive compound is applied to the lap.

In operation, the laps are reciprocated in the barrels through a crank action of the machine and, at the same time, the laps are swiveled backward and forward to impact a spiral motion to them. They are moved up and down at about fifty strokes a minute. Later a cylindrical lap is used to polish the rifling lands and increase the diameter of the bore to 0.303 inch, which is the caliber of the gun.

The next installment of this article, which will continue the description of barrel-machining and other operations, will appear in a coming number.

Fig. 12. After Rifling, the Barrels are Lapped Four at a Time with Lead Laps that are Cast in the Barrels Themselves

From Molten Steel

A Description of the Processes Followed in Producing Barrels for Bofors Guns, from the Melting Furnace to the Rough-turned and Straightened Barrels

By CHARLES O. HERB

Pouring Molten Steel for Guns from a Heroult Electric Furnace

METALLURGICAL skill of the highest order is required in producing the metal from which the barrels are made for Bofors anti-aircraft guns. The barrels for these 40-millimeter guns are of solid construction; that is, the rifle bore for the projectile is in the barrel itself and not in a separate liner inserted in the barrel, as in the case of larger guns. Because of this construction, the material from which the barrel is made must be as machinable as possible, in order to permit the performance of drilling, boring, honing, and rifling operations to a high degree of accuracy. At the same time, the material must be sufficiently wear-resistant to insure a comparatively long life, and strong enough to withstand the heavy stresses set up within the gun each time it is discharged.

Shells can be fired from these guns as fast as 120 per minute, a rate which causes rapid wear of the bore when the guns are being operated continuously. This means that heavy replacements of the barrels are necessary under conditions of severe aircraft bombardment. To build up a sufficient reserve of these gun barrels, the machine shops are working day and night—another indication of the importance of machine tools in successful warfare. It has been demonstrated that a trained crew can replace one of these gun barrels in the field within twenty seconds.

Bofors gun barrels for the defense of the British Empire are being forged in an Ontario steel plant. The methods used, from the time that the molten steel leaves the melting furnace to the end of the straightening operation which completes the work

TO GUN-BARREL FORGINGS

of this plant, are described in this article. The finishing operations on the barrels, which are performed in another plant, are described in the article beginning on page 174.

These gun barrels are forged from an alloy steel, produced in a Heroult electric melting furnace that delivers about twelve tons of molten steel per heat. It requires approximately 5 1/2 hours to produce the steel from hand-picked scrap and other constituents loaded into the furnace.

When the charge has reached the proper temperature, as checked by a metallurgist, and test bars have been cast from the melt, the charge is poured into a ladle lowered into a pit in the front of the furnace, as shown in the illustration on page 168. The ladle, which takes the entire capacity of the furnace, is then carried by an overhead crane, from which it is suspended, to a row of cast-iron molds placed upright on rails, as seen in the illustration Fig. 1.

The ingots produced in these molds weigh about 1225 pounds apiece. The molds are tapered, so that the ingots measure 9 1/2 inches square at the bottom by 12 1/2 inches square at the top. As they come from the molds, the ingots are 41 inches long. Clay necks or "hot tops" are placed on the molds, as seen in Fig. 1, to serve as reservoirs in which the metal remains molten to the last, thus insuring a constant supply of metal to the mold as cooling and consequent contraction of the ingot takes place. Each ladle load will fill nineteen or twenty molds. The ingots are marked and identified by means of a metal tag which is imbedded in the "hot top" metal.

When the temperature of the ingots has fallen sufficiently the molds are stripped from the now solid ingots by means of the overhead crane, and then transferred to oil-fired furnaces, such as seen in Fig. 2, which are located adjacent to the forging hammers.

Two of the three furnaces used are constructed with three compartments, as seen in Fig. 2, each of the compartments being provided with two doors. The third furnace has only two compartments. As

Fig. 1. Pouring the Molten Alloy Steel into Molds for the Casting of Ingots that are to be Forged into Barrels for Anti-aircraft Guns

many as eight ingots can be loaded into a compartment at one time. The temperature of the furnaces is closely controlled by means of Rayotube controllers.

Forging of the gun barrels from the ingots is performed under hammers of 8000 pounds rating in a series of three operations, between which various heat-treatments occur. One of these hammers is seen in Fig. 5. The first forging step consists of reducing the cross-section of the ingot to a diameter of 7 1/2 inches for the entire length of the forging, and at the same time increasing the length to approximately 4 1/2 feet. The forging is then cooled in powdered lime, which retards the rate of cooling, after which the forging is annealed and then "conditioned." "Conditioning" consists of inspecting the forging for surface imperfections and chipping and grinding away any defects.

The forging is then returned to the furnaces seen in Fig. 2 and reheated. The soaking period in this reheat and in a subsequent reheat is considerably longer than when the ingot was first placed in the furnace, the average soaking period for the three times that the steel is placed in the furnace being about ten hours. After the third and final forging operation, there is an excess length of about 16 inches at the muzzle end, which is 6 inches in diameter. This excess portion is later cut off to produce the required barrel length. A jib crane at the front of each air hammer facilitates moving the forging back and forth beneath the hammer and transferring the forging to and from the furnace.

When the forging of the gun barrels has been completed, the barrels are normalized to refine their grain structure, and are then annealed at a lower temperature to prepare the forgings for rough-turning.

Rough-turning of the barrel forgings is performed in the Bertram engine lathe seen in Fig. 3 which is equipped with two carriages for taking simultaneous cuts at opposite ends of the forging. The length of the forgings is somewhat over 10 feet when they reach the lathe, but the lathe bed is long enough to hold pieces 20 feet in length between the headstock and the tailstock.

Cobalt high-speed steel tools are employed for the rough-turning. The practice is to take two cuts along the straight surfaces of the forgings to a

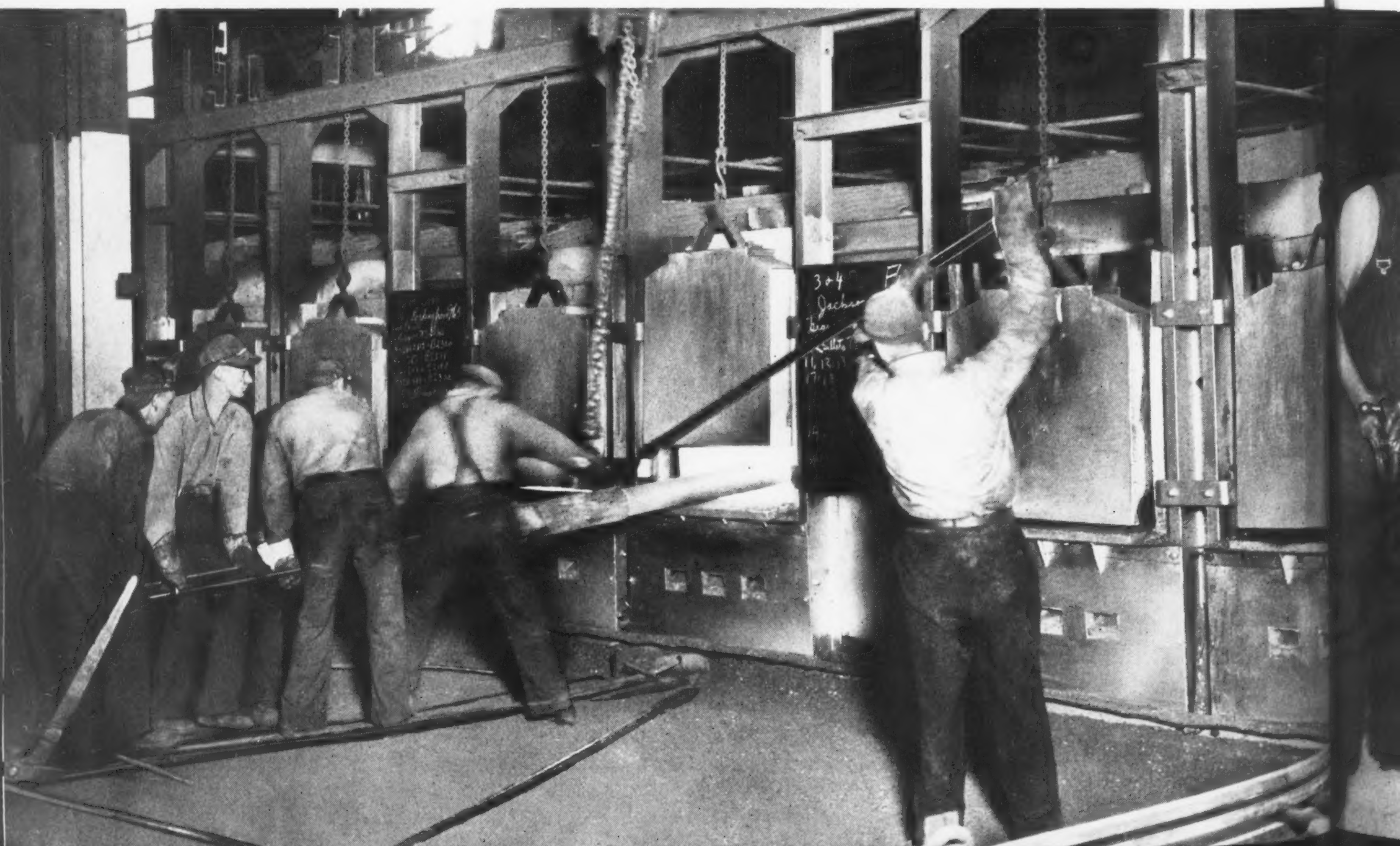


Fig. 2. Battery of Furnaces Employed for Heating the Ingots to Forging Temperature and for Reheating the Gun Barrels between Forging Operations

depth of about 1/16 inch each, and three cuts along the long tapered section. The taper cuts are taken by a tool on the right-hand carriage under the control of a taper attachment at the rear of the bed.

After the rough-turning operation, the gun barrels are heated in batches of six while suspended vertically in a Volta electric furnace, seen at the left in Fig. 6. This furnace is provided with a three-zone control through Micromax recording controllers. The temperature at which this furnace is operated is kept secret, but the work is held in it for a period of about eleven hours. At the end of this time, the six gun barrels are lifted together, as shown in the illustration, by means of an overhead crane and immersed with minimum delay in the oil quench tank seen at the right. The oil in this tank is kept in constant circulation. The gun barrels are held in the quench for a prescribed period, and then again returned to the Volta electric furnace for tempering. They are once more held in this furnace for eleven hours, but, of course, at a considerably lower temperature than before.

Upon removal of the guns from the tempering operation, they are partially cooled in air, after which they are taken to the Bertram straightening machine shown in Fig. 4, which is fitted with two anvils, as seen at the left end of the machine, which can be adjusted by turning a screw to obtain different center distances between the anvils up to 36 inches. Opposite the anvils is a ram which is reciprocated through a distance of 2 inches by the operation of an eccentric on a drive-shaft, so as to exert pressure on a gun barrel laid on top of the roller table in front of the anvils. The in-and-out position of the ram is also adjustable to suit the diameter of the gun barrel at the point against which pressure is to be applied. The table rollers facilitate moving the gun barrels lengthwise between the ram and anvils, so that pressure can be readily applied at any point along the forging.

After the straightening operation, the gun forgings are cut to length, a section being cut off both ends. This operation is performed by the Racine hydraulic shear-cut sawing machine shown in Fig. 7, which cuts off both ends in about one hour. At the end of each cut the saw trips itself and the saw frame is automatically raised to clear the work by a hydraulically actuated mechanism. Disks 7/8

Fig. 3. Rough-turning Gun Barrel at High Speed in a Lathe Having Two Carriages, the Right-hand Carriage being Controlled by a Taper Attachment

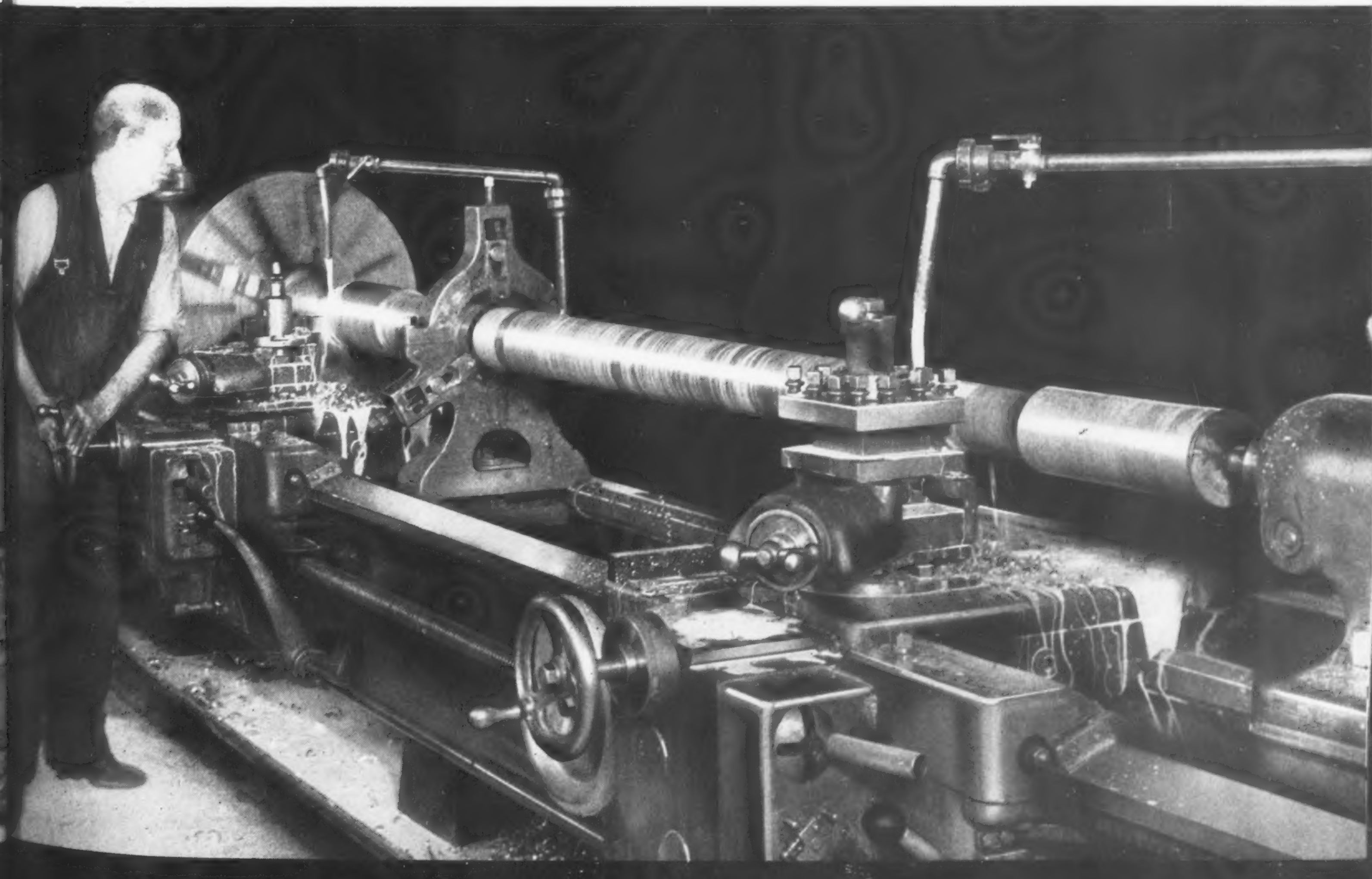


Fig. 4. Machine Used for Straightening the Gun Barrel at Any Point where Warping may have Occurred in Heat-treating after Rough-turning

HOW CANADA MAKES MUNITIONS

Fig. 5. Forging of a Gun Barrel is Performed in Three Operations beneath an 8000-pound Hammer, the Forging being Reheated between Each Operation

Fig. 6. The Gun Barrels are Heat-treated in Groups of Six, Suspended Twice in the Electric Furnace at Left, and Immersed in the Oil Quench at Right between Heats

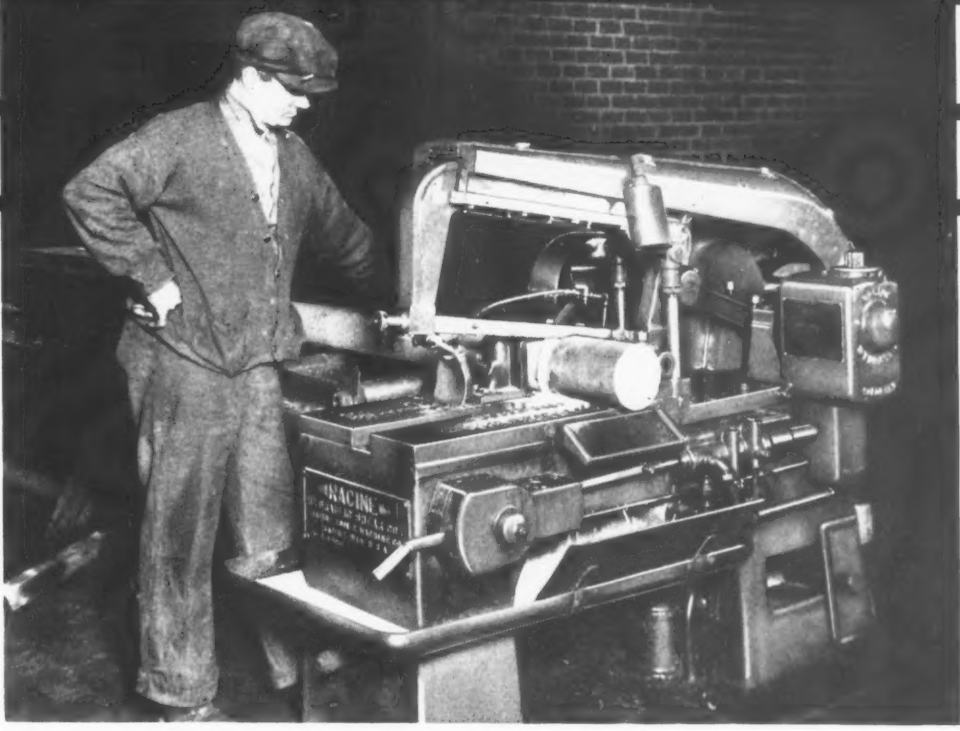
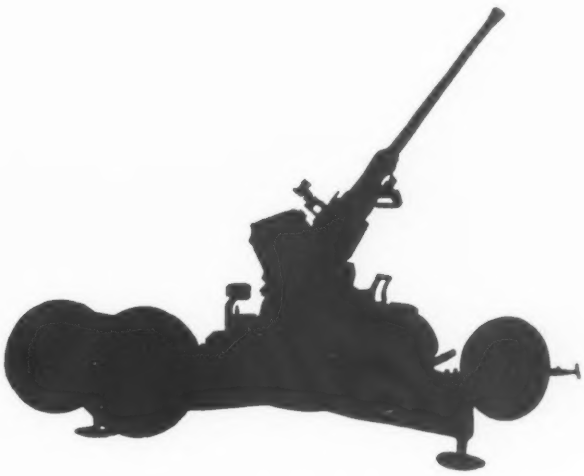


Fig. 7. Hydraulic Saw Employed for Cutting the Gun Barrels to Length and for Cutting off Disks of Steel for Making Physical Tests

inch thick are also cut from the muzzle and breech ends of the forging by a saw of this type for making circumferential physical tests, such as tensile, bending, and Izod impact tests. The test pieces are cut from positions as near the bore of the gun as possible; in fact, the tensile test piece is tangential to the bore. In this way, these tests are conducted on sections comparable to those on the gun barrel that will be stressed when the gun is in use. Disks cut from the barrel forging are etched in hydrochloric acid to determine the grain structure. Chemical analyses were, of course, made before forging was started on samples cast from the melt.

Upon the completion of all laboratory investigations on test pieces taken from the rough-turned gun barrels, the barrels are shipped to the plant in which they are finished by methods described in the article starting on page 174.



Machining Barrels

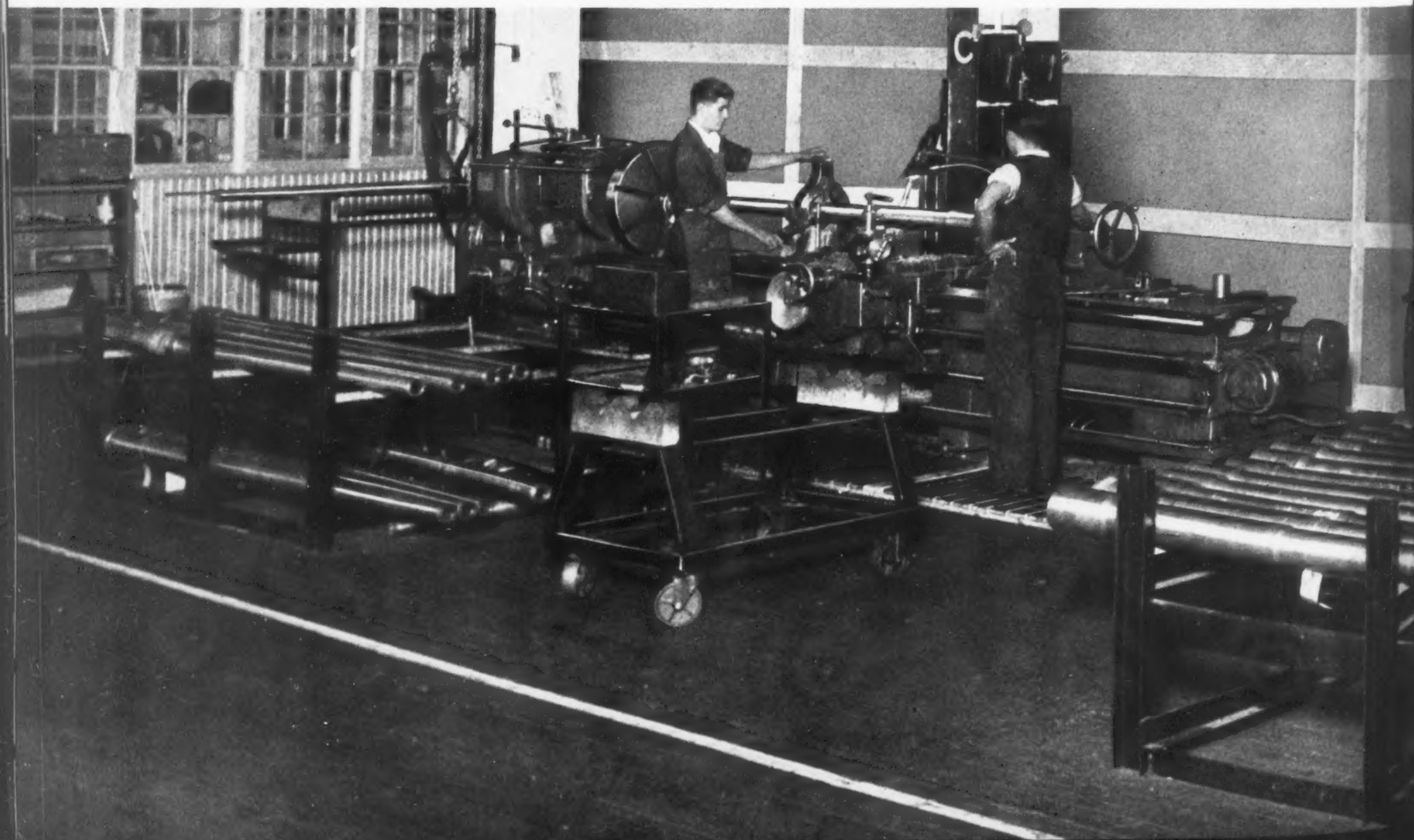
Workmanship of the Highest Order is Applied in Performing the Many Accurate Machining Operations Required in Finishing Barrels for Bofors 40-Millimeter Guns

By CHARLES O. HERB

MACHINING of the barrels for Bofors 40-millimeter anti-aircraft guns calls for the finest workmanship and the highest grade of machine tools, because of the great accuracy demanded in the finished barrels. The problem is made more difficult by the fact that the barrels are forged from an alloy steel of the maximum hardness consistent with economical machining.

Finishing of these barrels, which are forged by the methods outlined in the preceding article, is performed in an industrial plant in southeastern Ontario. When the barrels reach this plant, they are in the rough-turned condition seen at the right in Fig. 1, and when finished, they are of the appearance shown at the extreme left. A separate department for handling the gun barrels was set up in this plant and equipped with practically all new machine tools.

Incidentally, the Bofors guns are of a quick-firing type designed for shooting shells 40 millimeters



FOR BOFORS ANTI-AIRCRAFT GUNS

(1.5748 inches) in diameter at the rate of 120 rounds a minute. These guns have a range of 20,000 feet, and are intended for use in combination with 3.7-inch anti-aircraft guns which have a range of about 40,000 feet, or 7 miles.

The first operation on the gun-barrel forgings after they reach this plant is to center both ends simultaneously in a machine of double-end design. Then the barrels go to the Lo-Swing 8-inch lathe shown in Fig. 5, which is provided with four carriages for taking four cuts at one time. Six roller type back-rests support the work adequately under the heavy cuts taken. The depth of cut in the first operation in this machine is about 11 millimeters (7/16 inch) on the diameter. High-speed steel tools are employed.

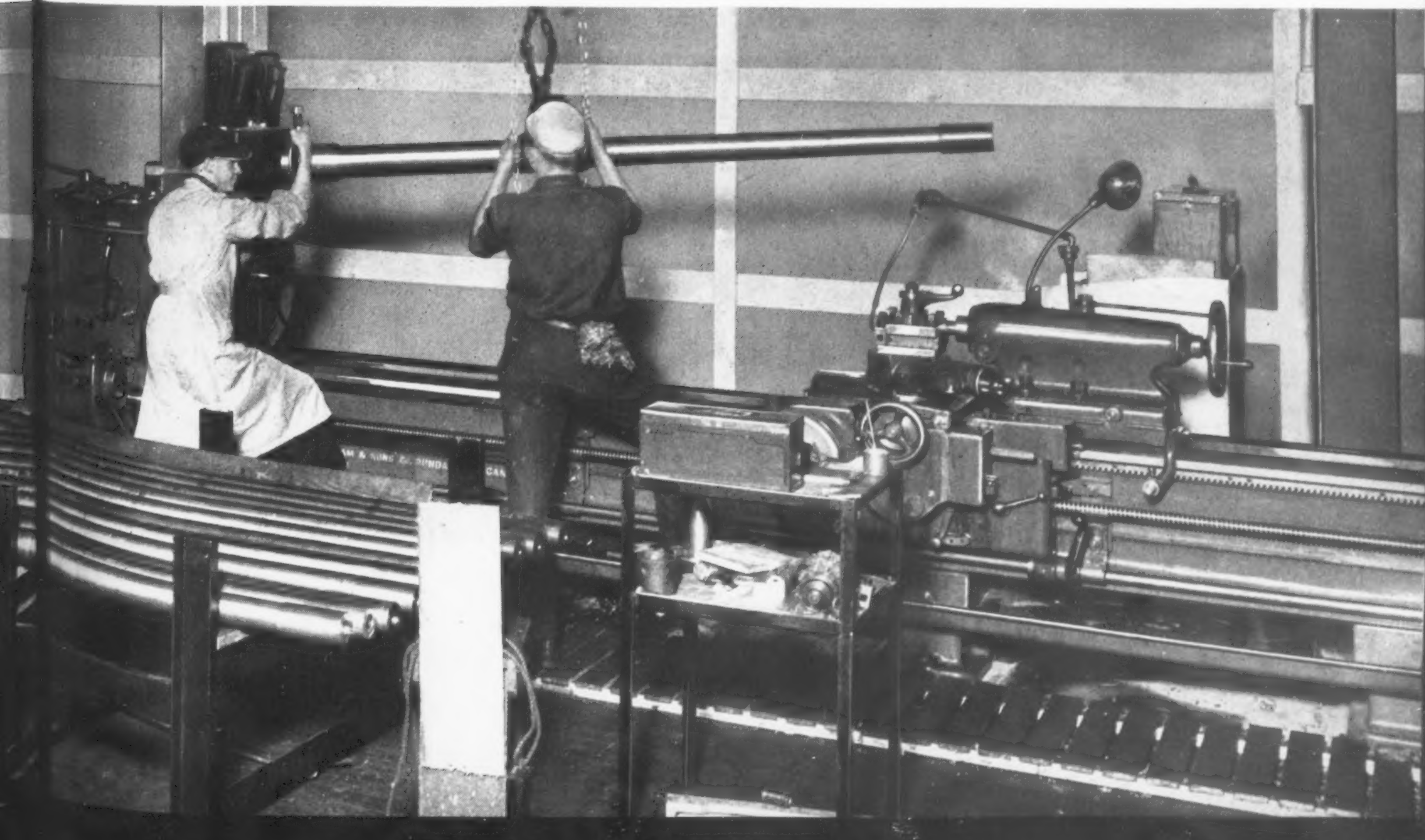
The tapered and stepped contour of the barrels is controlled by the use of a profile bar which extends along the front of the machine. Rollers riding along this bar operate plungers, which, in turn, actuate the blocks in which the tools are held, feeding the tools in or out while they are cutting. At the end of this operation, as well as of all succeeding operations, the gun barrel must be checked by a shop inspector before the operator removes the barrel from the machine.

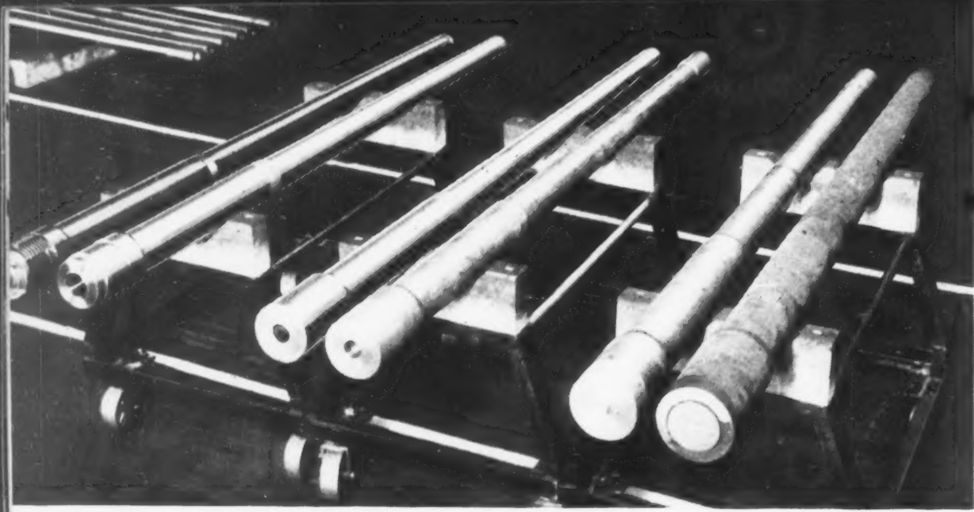
After this preliminary turning, the barrels are drilled the full length in a Pratt & Whitney gun drilling machine of the type shown in Fig. 2 which accommodates two barrels at one time. A single-lip tool of the gun drilling type is used to drill the barrels for their full length. The bar to which the drill is attached is provided with a channel on the under side through which the chips are washed out of the barrel by cutting oil that is supplied at a pressure of 200 pounds per square inch. The oil is forced to the drill cutting edges through a 3/16-inch hole in the center of the bar and the bit.

Drilling of the barrels is performed at the rate of 0.0011 inch per revolution of the barrel, the latter being run at a speed of 142 R.P.M. The drill is stationary, as is usual in gun drilling practice.

From the drilling operation, the gun barrels are returned to the Lo-Swing lathe shown in Fig. 5 for additional turning cuts in which the external surfaces are machined to within 3 millimeters (0.1181 inch) of the finished diameters.

The gun barrels go next to the LeBlond horizontal boring machine illustrated in Fig. 3, which employs a wood-packed tool bit having two cutting edges for boring the barrel the full length. The wood packs insure firm support of the cutting edges





MACHINING BARRELS

Fig. 1. Barrels for Bofors Anti-aircraft Guns in Various Stages of Manufacture, from the Rough-turned Forging to the Finished Barrel

on the tool bit and accurate guidance of the tool from the previously drilled hole. The wood packs are 0.003 inch over size. When they are fed into the breech end of the gun barrel, they are shaved to the exact size of the hole by the sharp edges at the opening of the hole.

The gun is chucked through the spindle of the boring machine, with the breech end held in a three-jaw chuck at the left end of the headstock. Push-boring is done from the muzzle end. The tools are so ground that the boring chips are deflected and washed out at that end. The boring-bar is piloted through a bushing in the housing in which the muzzle end of the barrel rotates. An additional steadyrest supports the boring-bar at a distance of 42 inches behind the boring head. This support is of the sliding type.

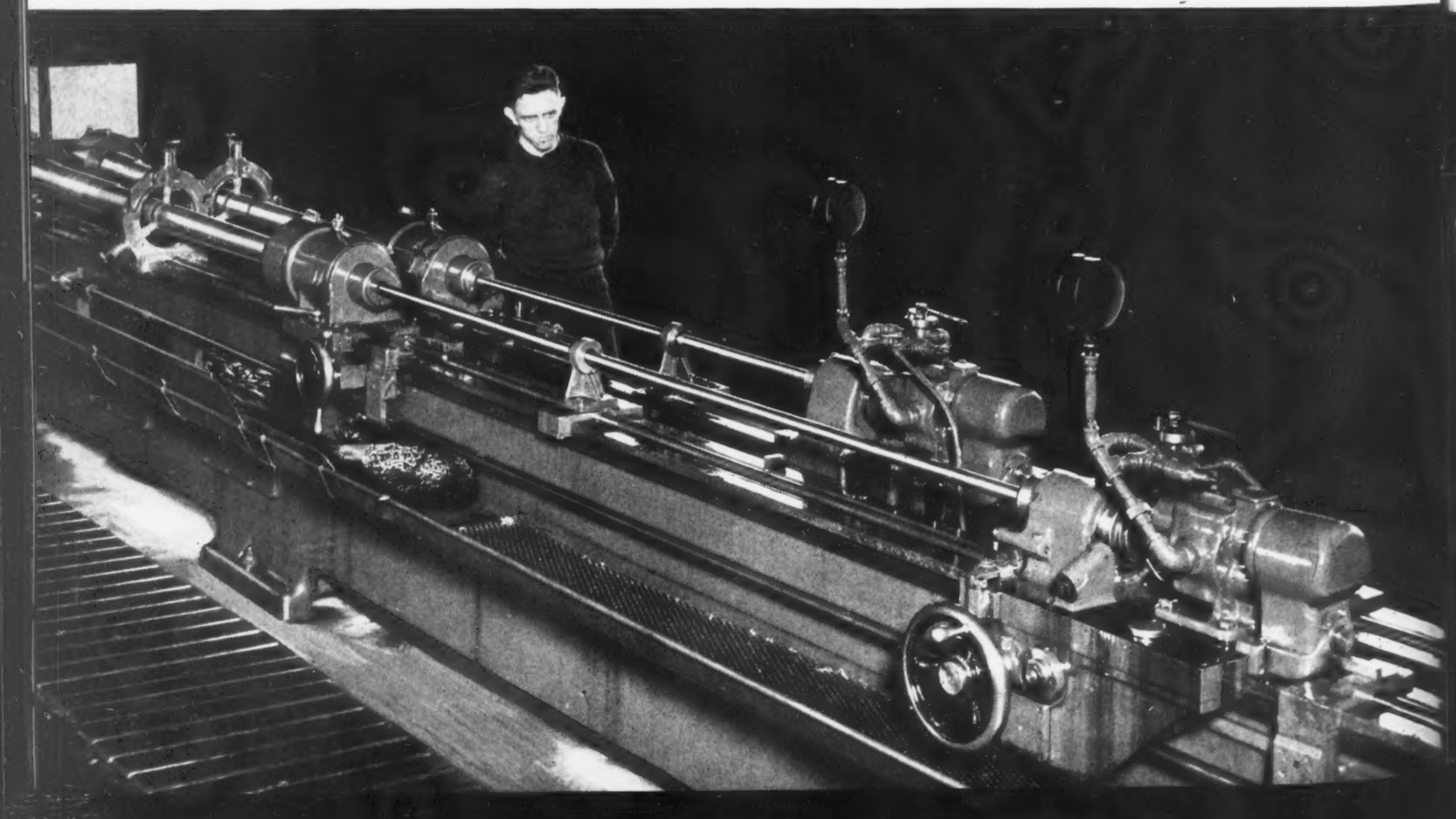
The steel cutting edges of the wood-packed bits are so ground that the chips are directed in front of the advancing tool and come out of the muzzle end of the gun barrel, which is nearest the headstock end of the machine. By this provision, any danger of the chips lodging between the wood packs and the bored surface is eliminated.

The cutting edges of the bit are sharpened and the wood packs are replaced after each operation. The boring-bar head is fed hydraulically, advancing the bit through the gun barrel at the rate of about 1/2 inch a minute. The floor-to-floor time for boring the barrel is approximately 3 1/2 hours. In this operation, the gun barrel is revolved at a speed of 165 R.P.M., while the tool bit remains stationary, as far as rotary movement is concerned.

Several turning operations on the tapered and cylindrical external surfaces of the gun barrel are now performed on a Bertram engine lathe having a swing of 26 inches and a maximum distance between centers of 11 feet. The surfaces are brought to the specified dimensions within a half millimeter (0.0197 inch), which leaves sufficient stock for removal by grinding.

An exacting inspection of the gun bore for

Fig. 2. Drilling Two Gun Barrels for their Full Length in a Pratt & Whitney Gun Drilling Machine of Conventional Design



straightness and concentricity with the external surfaces is next made with the equipment shown in Fig. 4. The gun barrel is laid on two roller rests of ball-bearing construction, which enables it to be easily rotated by hand. Circles of chalk are drawn around the barrel, every 6 inches from the breech end.

With one end of a long balanced lever registered against the spindle of a dial indicator, as seen in Fig. 4, a finger on the opposite end of this lever is brought successively in contact with the inside of the bore at points corresponding with the locations of the chalked circles around the outside of the barrel. At every point at which an inspection is being made in the bore, the corresponding external surface is supported by one of the roller rests. Any difference in the readings of the dial indicator will indicate out-of-roundness of the bore at the point being tested. The bore must be straight and concentric at this stage of the manufacturing procedure within 0.006 inch for its entire length.

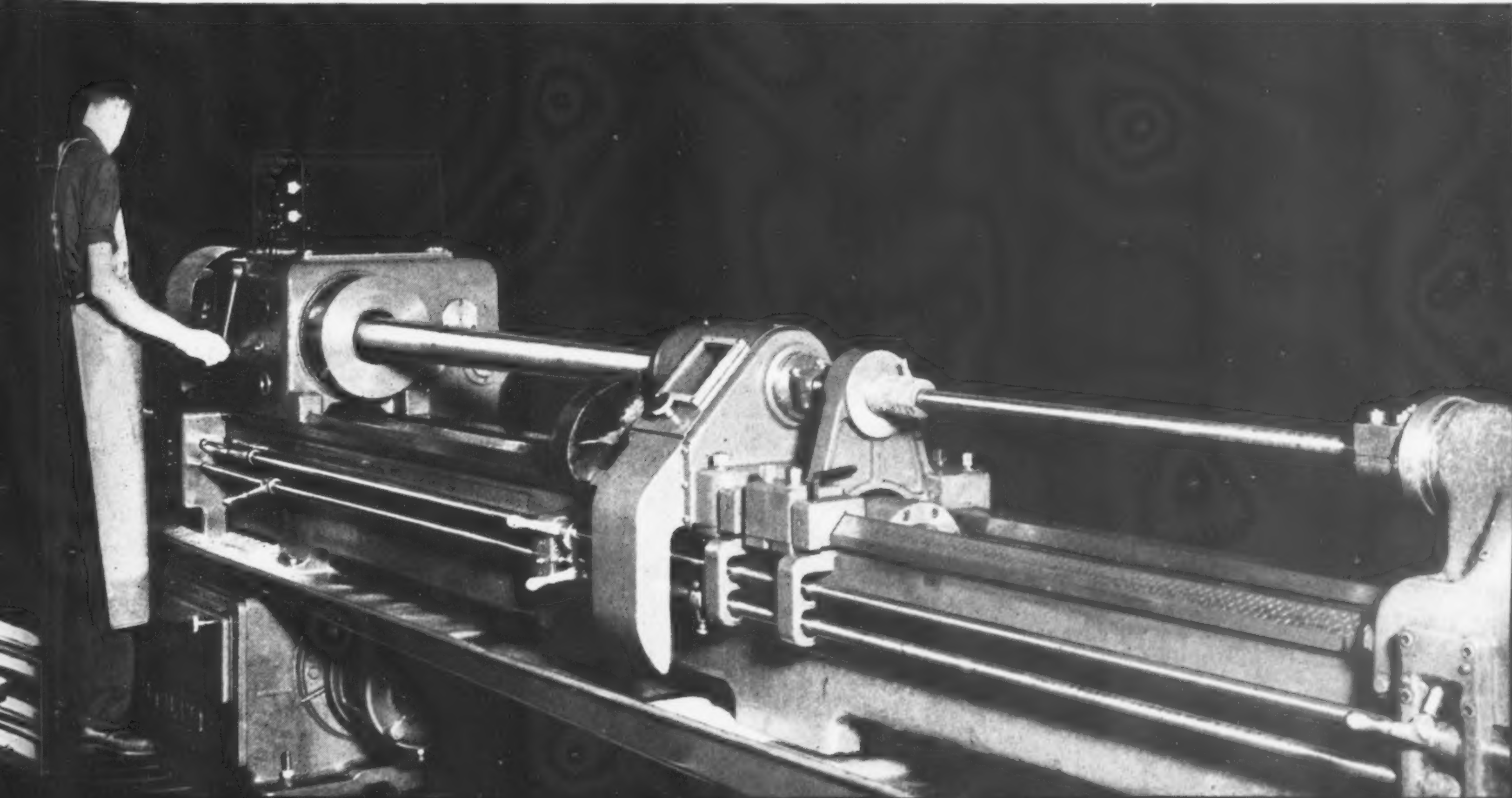
The gun barrels go next to the Barnes hydraulically actuated honing machine illustrated in Fig. 6. This machine is constructed with a bed at one end on which there are brackets fitted with bearings to receive the barrel and hold it with the bore in direct line with the honing bar. A Micromatic honing tool equipped with four stones of 38,320-I grit is employed in this operation. About 0.022 inch of stock on the diameter is removed to bring the bore to size within 0.04 millimeter or approximately 0.0015 inch and also straight for the full length within 0.002 inch.

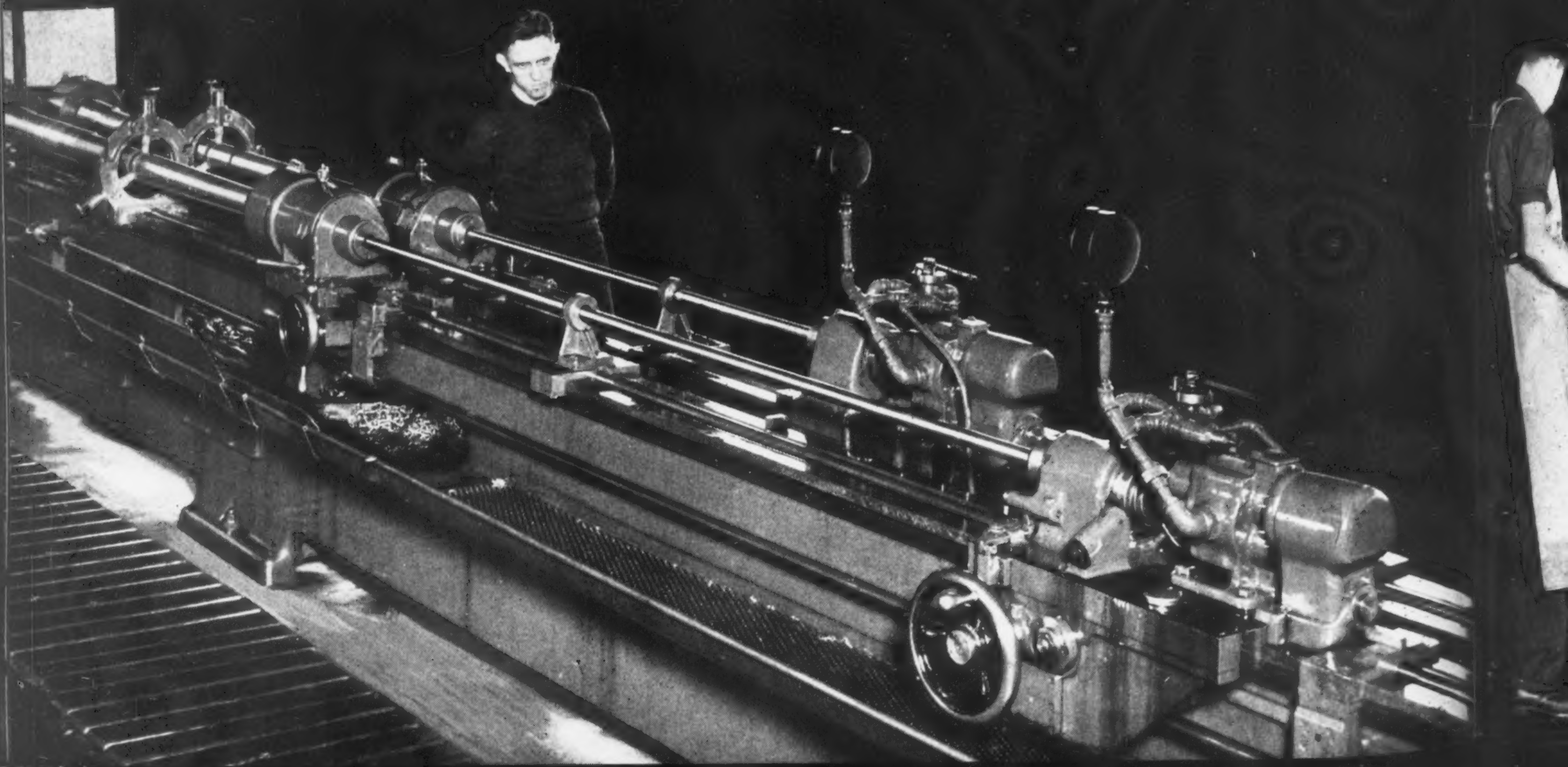
At the end of the honing operation, a ground plug gage, 15 inches long and only 0.0012 inch smaller in diameter than the honed bore, must be passed through the full length of the bore. If a bore is not straight within very close limits, this plug will bind. The diameter of the bore is checked every 3 inches of length by means of a gage provided with registering points which are applied both vertically and horizontally in the bore.

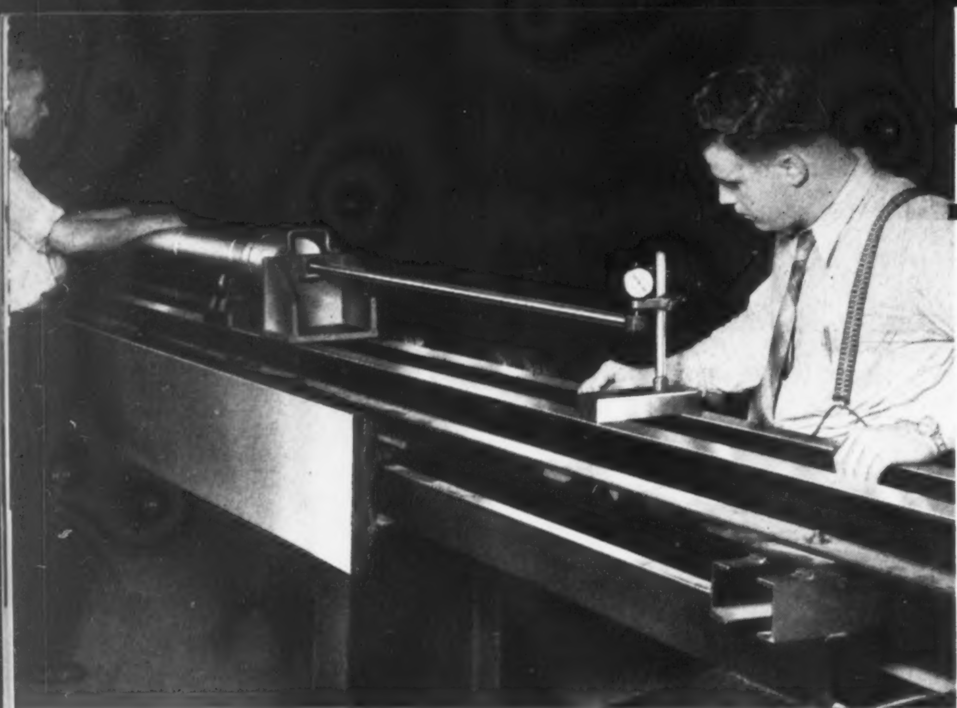
After the barrel is clamped in the brackets, 0.020 inch of stock on the diameter is rough-honed from the bore. The barrel is then placed on the floor to cool, and later the remaining 0.002 inch of stock is honed out to obtain the finished size. A compound consisting of 90 per cent of lard oil and 10 per cent of kerosene has been found unusually satisfactory for this operation. The floor-to-floor time is generally 2 3/4 hours, including inspection.

Upon completion of the honing operation, the gun barrels go to the Landis cylindrical grinding machine illustrated in Fig. 7 for grinding the long taper portion. For this operation, the breech end of the barrel is fitted with a solid ground plug that is supported by a center in the headstock, while the muzzle end is supported by an expanding arbor,

Fig. 3. Boring a Gun Barrel the Full Length on a LeBlond Machine with a Wood-packed Tool Bit Having Two Cutting Edges







MACHINING BARRELS FOR

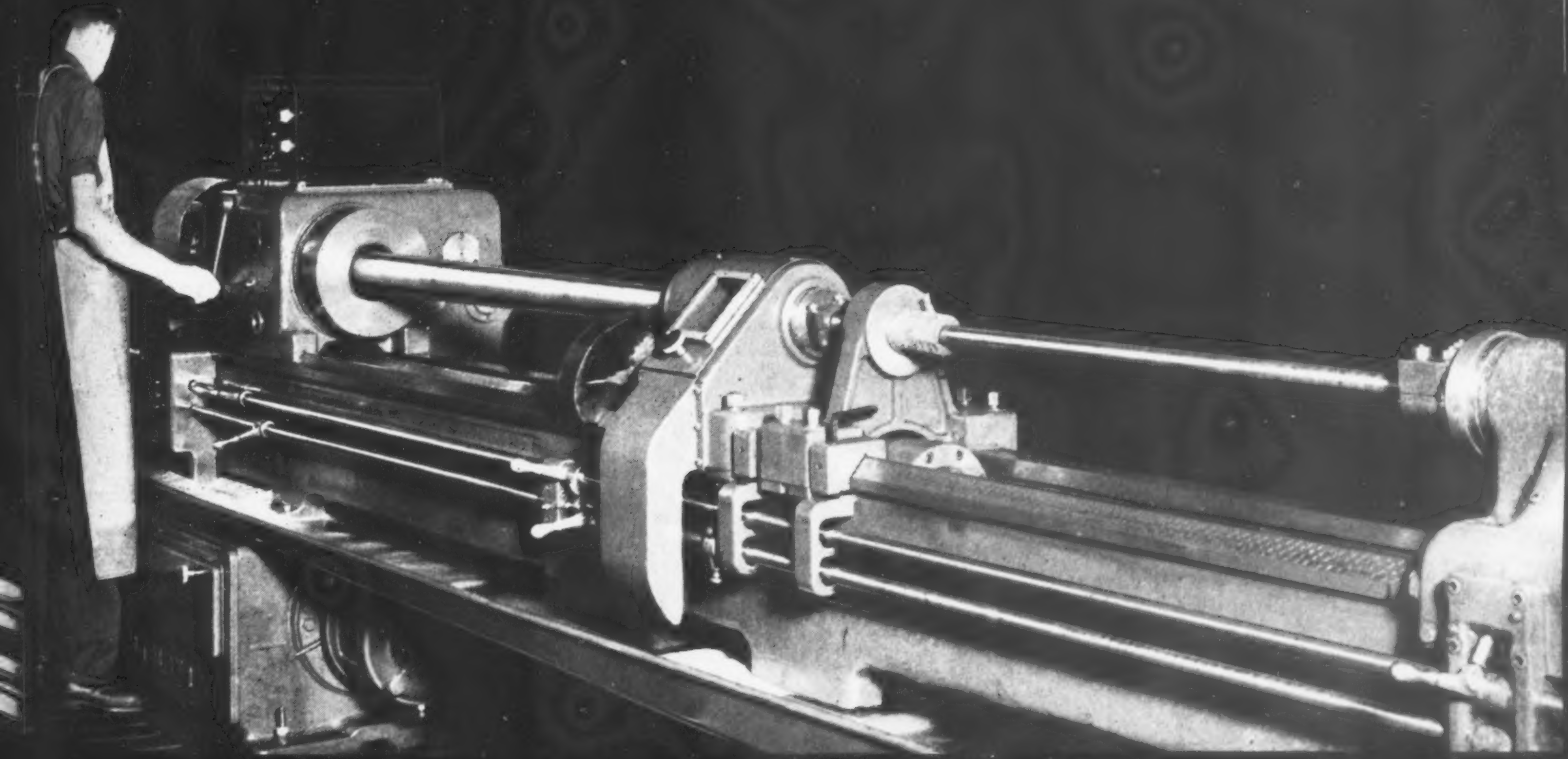
Fig. 4. The Bore of the Gun Barrel is Checked for Concentricity with the External Surfaces Every 6 Inches of Length

which is held by the tailstock center. The tailstock is set over the required distance with respect to the headstock for grinding the taper. Four rests at the front of the machine prevent springing of the barrel under the grinding pressure.

A similar machine is employed for grinding the straight cylindrical portions of the gun barrels. It is the practice to grind off stock to the extent of 0.020 inch on the diameter of all surfaces, so as to remove any concentric rings left from the turning operations and to bring the outside surface concentric with the bore. The accuracy of all remaining operations on the internal surfaces is, of course, dependent on the accuracy of the straight cylindrical external surfaces, as the barrels are located from these surfaces in subsequent operations. All external surfaces are held to within plus or minus 0.001 inch for diameter and for concentricity.

The operations involved in machining the chamber surfaces in the breech end of the gun barrels limits. This is an especially difficult problem in view of the fact that four of the chamber surfaces are tapered. The chambering operation is performed in one of the Bertram engine lathes seen in the illustrations on pages 174 and 175. The first cut consists of rough-boring with a single-point tool to bring the surfaces to size within 0.015 inch.

After roughing the chamber, the first or long taper is bored to the finished size by means of a tangent bar held in a bracket. This bar has a dovetailed groove extending along its length, with a taper corresponding to the bore taper. A bar carrying the boring tool fits snugly into the dovetailed slot, and is pushed along at a suitable feed by a rod extending from the tool-holder on the compound rest. The three remaining tapered surfaces are rough-machined with a reamer. These surfaces are then finish-machined by a reamer having a pilot that registers with the honed bore of the barrel in front of the chamber, as seen in Fig. 8.



ANTI-AIRCRAFT GUNS

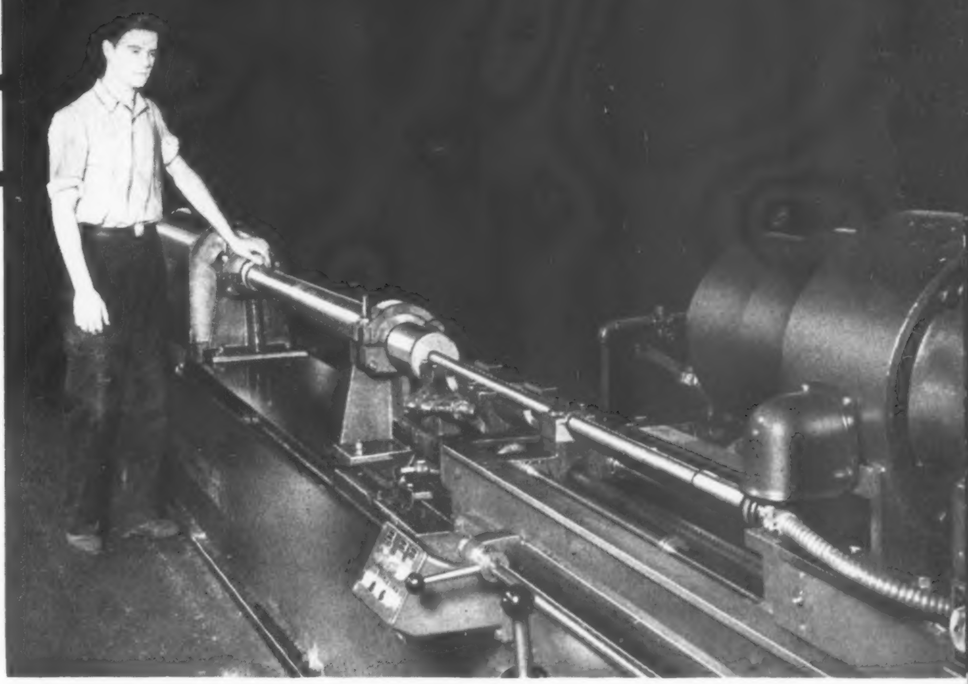


Fig. 6. Each Barrel Bore is Honed to Size on a Barnes Hydraulically Actuated Machine of Horizontal Design

moval by lapping. The lapping is done by applying different grades of emery paper to an ash stick and passing the stick back and forth along the revolving chamber surfaces until all ridges or scores are removed. The entire chamber must be so smooth after lapping that there will be no minute ridges into which brass can be forced when a shell is discharged, which might interfere with the functioning of the cartridge extractors. To determine whether all ridges have been lapped away, a long cylindrical piece of gutta-percha is squeezed into the finished chamber. If there are any minute metal ridges in the chamber, they will be indicated on the surfaces of the gutta-percha.

An indicator gage seen mounted on the tool-block in Fig. 8 is used to check the depth of cut taken in boring and reaming the chamber surfaces. The chamber is checked for accuracy of dimensions by means of four gages, one for each taper, after which a composite gage is employed to check all

After the chamber has been finished, the gun barrel is placed in the other Bertram engine lathe seen in the heading illustration for "breeching." Here the dovetail recesses of the breech are machined, several external surfaces are formed, and a brass ring is peened into an external groove. The breech end is also faced to obtain the specified distance from the chamber.

Threads are machined around the straight cylindrical surface on the breech end of the gun barrels in a Pratt & Whitney thread milling machine. The thread is of modified Acme form and has a lead of 10 millimeters (0.3937 inch). A single type milling cutter is employed for this operation.

Rifling of the gun barrel bore is another operation of prime importance. Grooves to form the rifle are machined to a helix that changes constantly at increasing angles from the chamber to the muzzle end of the barrel. The grooves are produced by a tool which removes from 0.001 to 0.0015 inch of

Fig. 4. The Bore of the Gun Barrel is Checked for Concentricity with the External Surfaces Every 6 Inches of Length

which is held by the tailstock center. The tailstock is set over the required distance with respect to the headstock for grinding the taper. Four rests at the front of the machine prevent springing of the barrel under the grinding pressure.

A similar machine is employed for grinding the straight cylindrical portions of the gun barrels. It is the practice to grind off stock to the extent of 0.020 inch on the diameter of all surfaces, so as to remove any concentric rings left from the turning operations and to bring the outside surface concentric with the bore. The accuracy of all remaining operations on the internal surfaces is, of course, dependent on the accuracy of the straight cylindrical external surfaces, as the barrels are located from these surfaces in subsequent operations. All external surfaces are held to within plus or minus 0.001 inch for diameter and for concentricity.

The operations involved in machining the chamber surfaces in the breech end of the gun barrels are most important, as all of these surfaces must be concentric with the bore within extremely close limits. This is an especially difficult problem in view of the fact that four of the chamber surfaces are tapered. The chambering operation is performed in one of the Bertram engine lathes seen in the illustrations on pages 174 and 175. The first cut consists of rough-boring with a single-point tool to bring the surfaces to size within 0.015 inch.

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Approximately 0.001 inch of stock on the diameter is left on the various chamber surfaces for re-

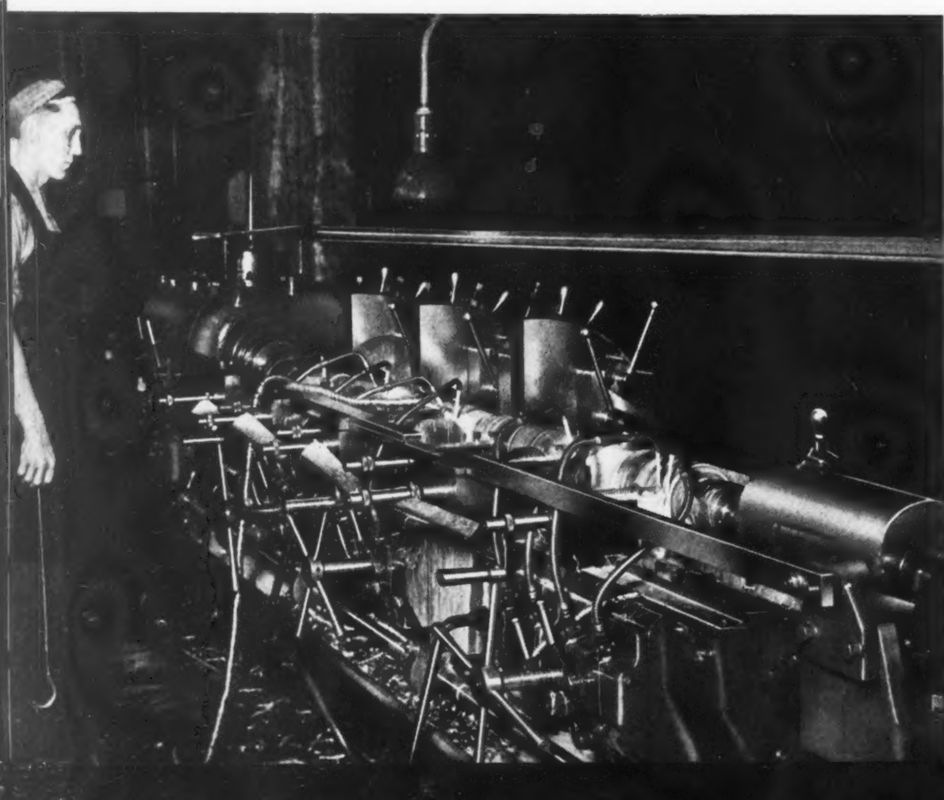

Fig. 5. Lo-Swing Lathe Equipped with Four Carriages, which is Used for Performing Several Turning Operations on the Gun Barrels

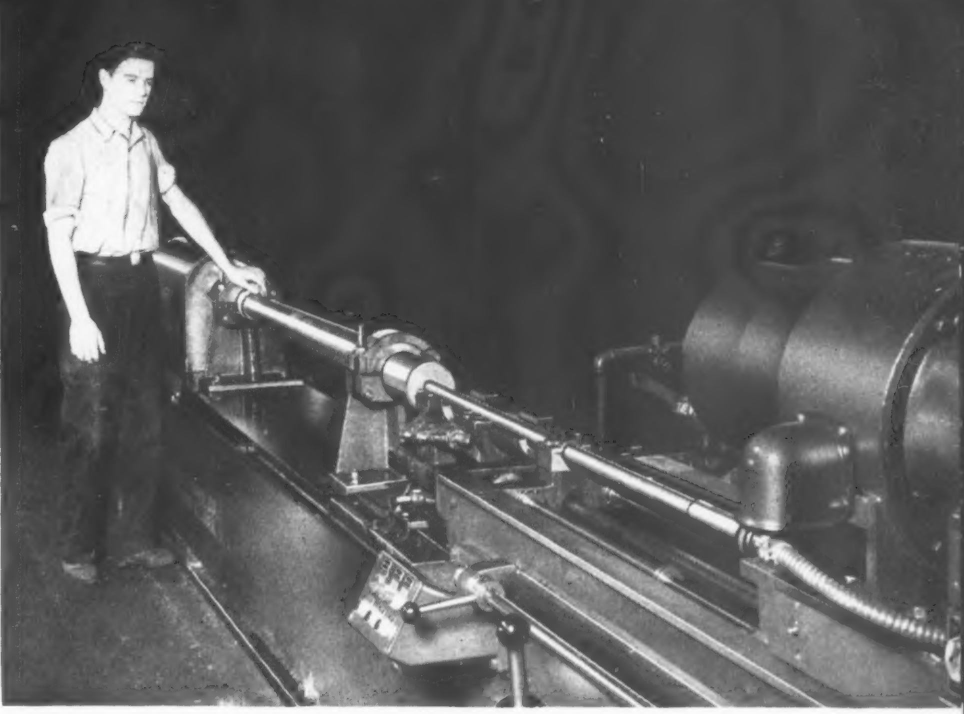

Fig. 6. Each Barrel Bore is Honed to Size on a Barnes Hydraulically Actuated Machine of Horizontal Design

moval by lapping. The lapping is done by applying different grades of emery paper to an ash stick and passing the stick back and forth along the revolving chamber surfaces until all ridges or scores are removed. The entire chamber must be so smooth after lapping that there will be no minute ridges into which brass can be forced when a shell is discharged, which might interfere with the functioning of the cartridge extractors. To determine whether all ridges have been lapped away, a long cylindrical piece of gutta-percha is squeezed into the finished chamber. If there are any minute metal ridges in the chamber, they will be indicated on the surfaces of the gutta-percha.

An indicator gage seen mounted on the tool-block in Fig. 8 is used to check the depth of cut taken in boring and reaming the chamber surfaces. The chamber is checked for accuracy of dimensions by means of four gages, one for each taper, after which a composite gage is employed to check all four tapers at one time. The composite gage may be seen in Fig. 8 at the front of the machine bed.

After the chamber has been finished, the gun barrel is placed in the other Bertram engine lathe seen in the heading illustration for "breeching." Here the dovetail recesses of the breech are machined, several external surfaces are formed, and a brass ring is peened into an external groove. The breech end is also faced to obtain the specified distance from the chamber.

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Rifling of the gun barrel bore is another operation of prime importance. Grooves to form the rifle are machined to a helix that changes constantly at increasing angles from the chamber to the muzzle end of the barrel. The grooves are produced by a tool which removes from 0.001 to 0.0015 inch of stock at each successive pass through the full length of the barrel bore.

Fig. 7. Grinding the Tapered Part of a Barrel on a Landis Cylindrical Grinding Machine, a Similar Machine being Used for the Straight Sections

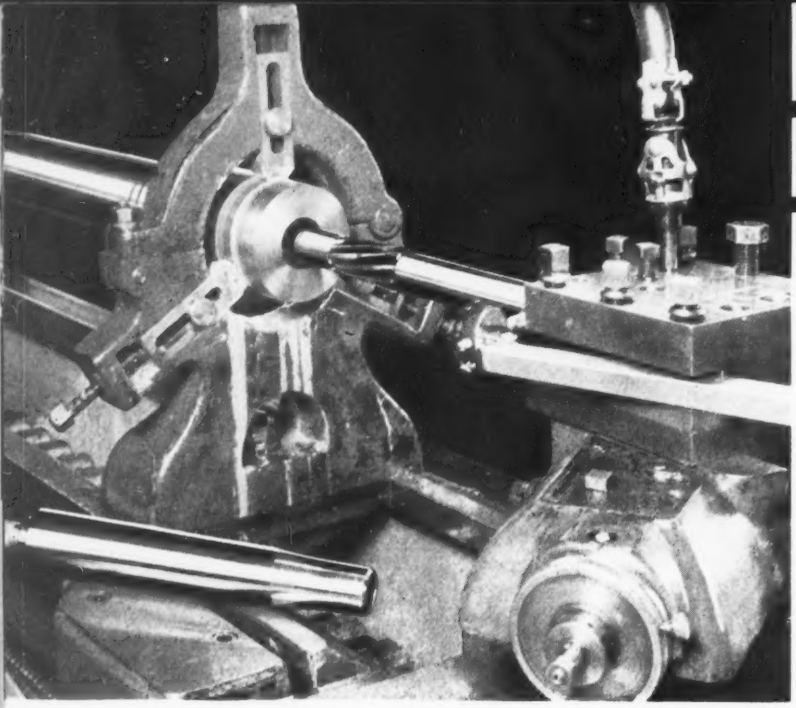


Fig. 8. Reaming the Chamber in the Breech End of the Gun to Fit the Plug Gage Seen Lying on the Lathe Bed, which has Four Surfaces Having Different Degrees of Taper

Rifling is performed in a LeBlond machine, a close-up view of which is seen in Fig. 9. A single-point tool is mounted in an auxiliary bar attached to the front end of a master bar, which is revolved at an accelerated rate as the cutter advances through the barrel bore. The practice is to cut the original grooves from the breech end of the gun, which is held in the headstock of the machine, to the muzzle end, which is supported in a combination chuck and indexing fixture, as seen in the illustration. In other words, the tool is pulled through the gun barrel by hydraulic pressure rather than pushed through it. The indexing fixture is also hydraulically controlled, and is fully automatic. It indexes the work through the distance between two grooves with each return of the cutter to its starting position.

The swiveling of the cutter-bar at the changing rate necessary to obtain the helical path of the rifling grooves is accomplished by a groove in the master bar, the latter being seen in the right foreground in Fig. 9. A roller in the unit that supports the master bar in front of the indexing unit rides in this groove and causes the master bar to swivel accordingly, as it is fed in a longitudinal direction.

The groove in the master bar was cut on the rifling machine by means of a shaper attachment provided with a cutter that removed stock as the master bar was fed past the attachment, and at the same time, revolved in accordance with the curvature of a steel ribbon positioned on the table at the back of the machine. This steel ribbon is carefully set up and clamped on the table to develop the rifling helix on the master bar.

In the rifling operation, the practice is to cut a groove to a depth of 0.001 or 0.0015 inch with one stroke of the cutter, as previously mentioned, and then index the work after the cutter has been returned through the groove to the far end of the gun barrel. A cut of the same depth is then taken in all the grooves, after which the cutter is adjusted to a greater depth and another cut taken in all grooves. This cycle is repeated until approximately twenty cuts have been made in each groove.

The settings of the cutter are adjusted by means of a graduated collar on a head attached to the master bar, there being twenty-five graduations for an adjustment of 0.001 inch. This insures extreme accuracy in changing cutter settings. Each time that the cutter returns through the groove machined during the forward stroke of the master bar, it is automatically receded in its holder, so as to avoid scraping the groove. The outward feeding and receding movements of the cutter are effected by a draw-bar which extends through a hole in the center of the auxiliary bar. Coolant is supplied to the cutter through the hollow master bar and a hole in the auxiliary bar. Brushes immediately in front of the cutter carry all chips to the ends of the gun barrel, a provision that eliminates scoring of the rifling grooves. Four cast-iron strips on the cutter-holder serve to pilot it in the honed bore.

Fig. 9. Rifling of the Gun Barrel is Accomplished by Pulling a Single-point Cutter through the Barrel about Three Hundred Times and Indexing between Each Stroke

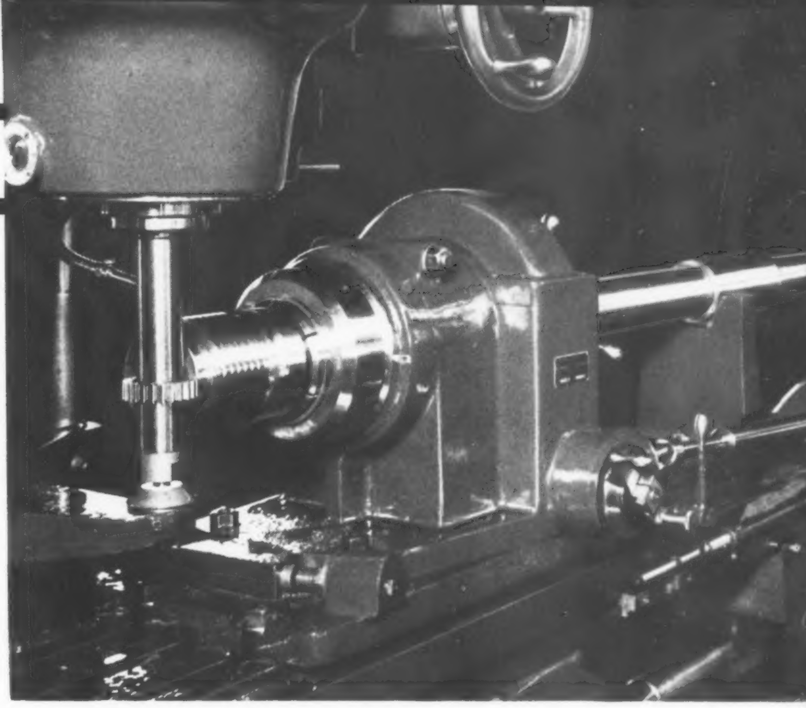


Fig. 10. Machining Operations within Close Tolerances are Performed on the Breech End of the Gun by Means of the Vertical-spindle Milwaukee Milling Machine Here Shown

It takes about eight hours to rifle one of these gun barrels. At the end of the operation, "Go" and "No Go" gages are employed to check the accuracy of the rifling grooves at the two ends of the gun barrel, and gutta-percha impressions are taken of the complete rifled bore.

At the end of the rifling operation, the gun barrels go to the Milwaukee vertical-spindle milling machine shown in Fig. 10 for milling extractor slots on the breech end, as seen in the illustration, and also for milling the locking slot and abutment faces. The breech end of the gun barrel is held in a special work fixture of indexing type. The muzzle end is supported by a large bracket near the outer end of the table, a sleeve being slipped on the barrel to protect the finish at the point where it is supported. All milling must be performed in relation to the point where the external thread starts. Set-ups are made by means of indicators.

The gun barrels go next to the Bertram shaper shown in Fig. 11, where the milled threads on the breech end are cut away at three points around the barrel, as seen on the finished gun at the extreme left in Fig. 1. This is done to obtain an interrupted thread that provides a means of quickly mounting and dismounting the breech ring when the gun is in service. The exact locations where the threads are to be cut away are determined from a fixture mounted on the breech end of the barrel, as seen in Fig. 11. There are ground locating surfaces around this fixture from which the tools are set by the use of feeler gages. The shaper is equipped with a worm-operated indexing fixture to locate the various sections of the breech thread with respect to the shaper ram. A special bracket on the table supports the gun barrel about 3 feet in front of the table.

At the end of this shaping operation, the gun barrels go to an engine lathe that is equipped with a metric lead-screw, in which a thread of 2 millimeters pitch is machined in the center of the barrel to accommodate a spring holder. Up to this point in the manufacturing procedure, the gun barrel is 1 inch longer than the finished barrel is to be. This amount of stock is cut away from the muzzle end while the gun barrel is in the same lathe. Also, the muzzle end is turned to a thread diameter and threads of 2 millimeters pitch are cut to receive a flash guard.

Hand filing and scraping of the external surfaces on the breech end are next performed to remove all tool marks. Then the crest of the British Government, the name of the maker of the gun, etc., are etched on the outside of the barrel. Finally, the barrels are Parkerized for one hour. Before this operation is performed, however, the breech end is covered with a cap that fits into the chamber and a plug is inserted in the muzzle end to prevent the Parkerizing material from getting on the internal surfaces of the barrel.

This completes the machining of the Bofors gun barrels, except for the attachment of several accessories in the assembly department.

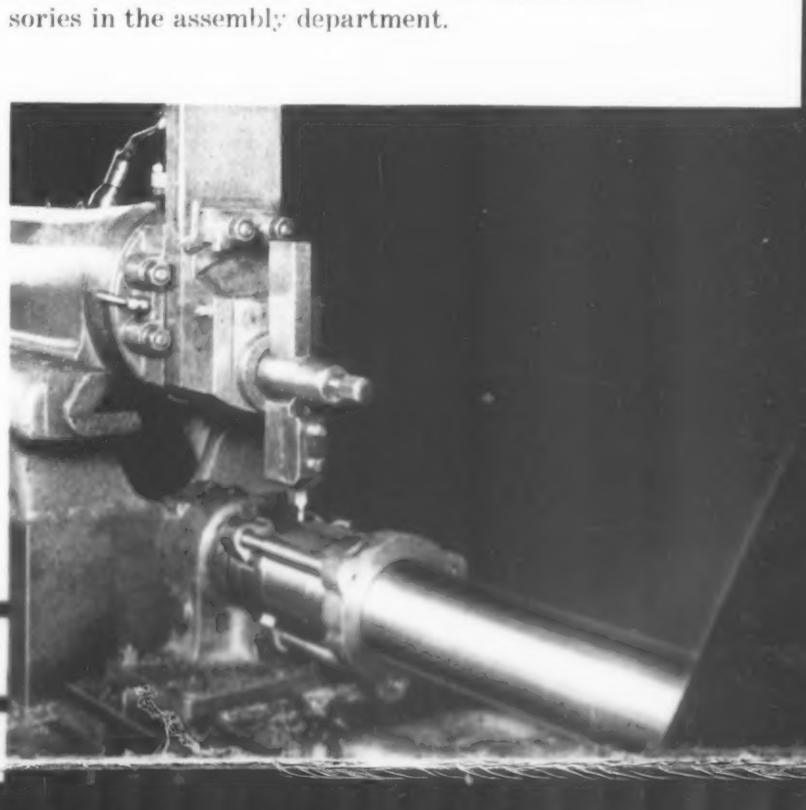


Fig. 11. Bertram Shaper Used for Cutting away Portions of the Thread on the Breech End of the Barrel to Permit Quick Assembly of the Barrel to the Breech Ring

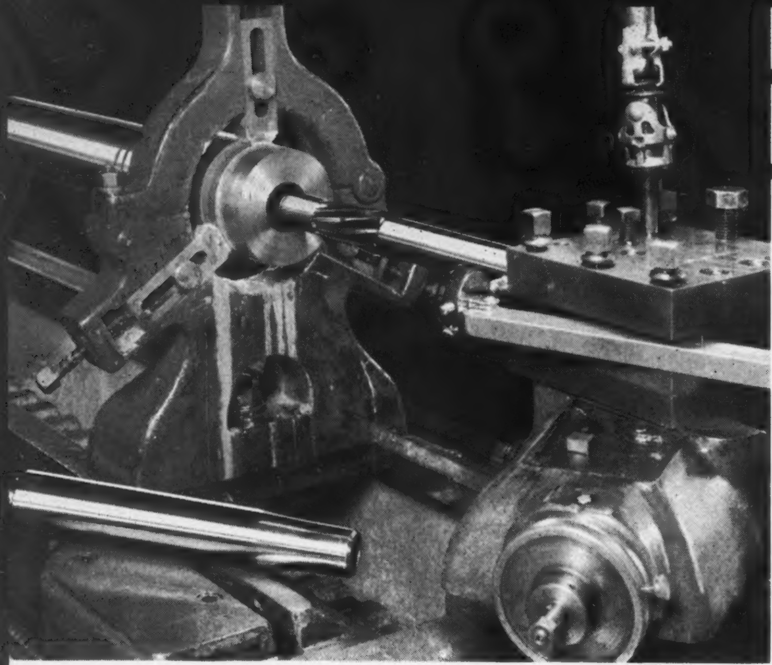


Fig. 8. Reaming the Chamber in the Breech End of the Gun to Fit the Plug Gage Seen Lying on the Lathe Bed, which has Four Surfaces Having Different Degrees of Taper

Rifling is performed in a LeBlond machine, a close-up view of which is seen in Fig. 9. A single-point tool is mounted in an auxiliary bar attached to the front end of a master bar, which is revolved at an accelerated rate as the cutter advances through the barrel bore. The practice is to cut the original grooves from the breech end of the gun, which is held in the headstock of the machine, to the muzzle end, which is supported in a combination chuck and indexing fixture, as seen in the illustration. In other words, the tool is pulled through the gun barrel by hydraulic pressure rather than pushed through it. The indexing fixture is also hydraulically controlled, and is fully automatic. It indexes the work through the distance between two grooves with each return of the cutter to its starting position.

The swiveling of the cutter-bar at the changing rate necessary to obtain the helical path of the rifling grooves is accomplished by a groove in the master bar, the latter being seen in the right foreground in Fig. 9. A roller in the unit that supports the master bar in front of the indexing unit rides in this groove and causes the master bar to swivel accordingly, as it is fed in a longitudinal direction.

The groove in the master bar was cut on the rifling machine by means of a shaper attachment provided with a cutter that removed stock as the master bar was fed past the attachment, and at the same time, revolved in accordance with the curvature of a steel ribbon positioned on the table at the back of the machine. This steel ribbon is carefully set up and clamped on the table to develop the rifling helix on the master bar.

In the rifling operation, the practice is to cut a groove to a depth of 0.001 or 0.0015 inch with one stroke of the cutter, as previously mentioned, and then index the work after the cutter has been returned through the groove to the far end of the gun barrel. A cut of the same depth is then taken in all the grooves, after which the cutter is adjusted to a greater depth and another cut taken in all grooves. This cycle is repeated until approximately twenty cuts have been made in each groove.

The settings of the cutter are adjusted by means of a graduated collar on a head attached to the master bar, there being twenty-five graduations for an adjustment of 0.001 inch. This insures extreme accuracy in changing cutter settings. Each time that the cutter returns through the groove machined during the forward stroke of the master bar, it is automatically receded in its holder, so as to avoid scraping the groove. The outward feeding and receding movements of the cutter are effected by a draw-bar which extends through a hole in the center of the auxiliary bar. Coolant is supplied to the cutter through the hollow master bar and a hole in the auxiliary bar. Brushes immediately in front of the cutter carry all chips to the ends of the gun barrel, a provision that eliminates scoring of the rifling grooves. Four cast-iron strips on the cutter-holder serve to pilot it in the honed bore.

Fig. 9. Rifling of the Gun Barrel is Accomplished by Pulling a Single-point Cutter through the Barrel about Three Hundred Times and Indexing between Each Stroke

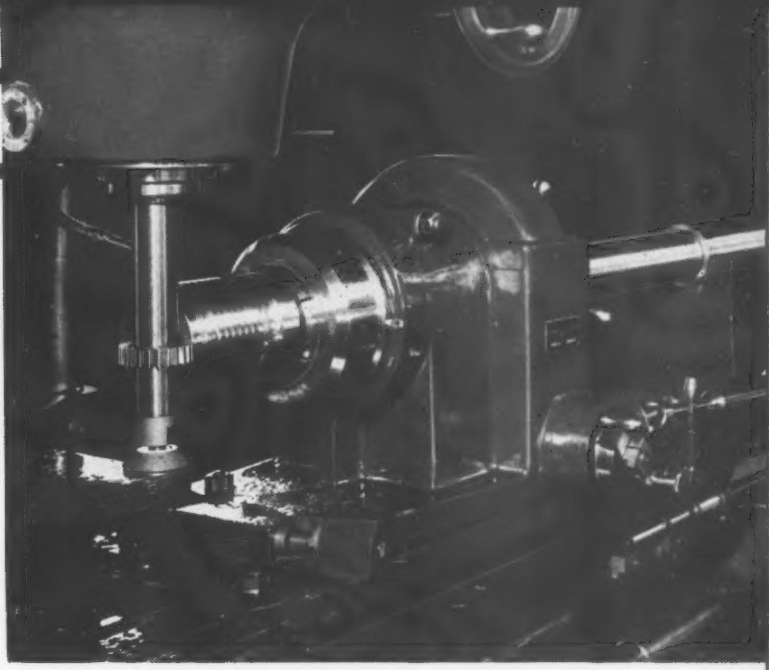


Fig. 10. Machining Operations within Close Tolerances are Performed on the Breech End of the Gun by Means of the Vertical-spindle Milwaukee Milling Machine Here Shown

It takes about eight hours to rifle one of these gun barrels. At the end of the operation, "Go" and "No Go" gages are employed to check the accuracy of the rifling grooves at the two ends of the gun barrel, and gutta-percha impressions are taken of the complete rifled bore.

At the end of the rifling operation, the gun barrels go to the Milwaukee vertical-spindle milling machine shown in Fig. 10 for milling extractor slots on the breech end, as seen in the illustration, and also for milling the locking slot and abutment faces. The breech end of the gun barrel is held in a special work fixture of indexing type. The muzzle end is supported by a large bracket near the outer end of the table, a sleeve being slipped on the barrel to protect the finish at the point where it is supported. All milling must be performed in relation to the point where the external thread starts. Set-ups are made by means of indicators.

The gun barrels go next to the Bertram shaper shown in Fig. 11, where the milled threads on the breech end are cut away at three points around the barrel, as seen on the finished gun at the extreme left in Fig. 1. This is done to obtain an interrupted thread that provides a means of quickly mounting and dismounting the breech ring when the gun is in service. The exact locations where the threads are to be cut away are determined from a fixture mounted on the breech end of the barrel, as seen in Fig. 11. There are ground locating surfaces around this fixture from which the tools are set by the use of feeler gages. The shaper is equipped with a worm-operated indexing fixture to locate the various sections of the breech thread with respect to the shaper ram. A special bracket on the table supports the gun barrel about 3 feet in front of the table.

At the end of this shaping operation, the gun barrels go to an engine lathe that is equipped with a metric lead-screw, in which a thread of 2 millimeters pitch is machined in the center of the barrel to accommodate a spring holder. Up to this point in the manufacturing procedure, the gun barrel is 1 inch longer than the finished barrel is to be. This amount of stock is cut away from the muzzle end while the gun barrel is in the same lathe. Also, the muzzle end is turned to a thread diameter and threads of 2 millimeters pitch are cut to receive a flash guard.

Hand filing and scraping of the external surfaces on the breech end are next performed to remove all tool marks. Then the crest of the British Government, the name of the maker of the gun, etc., are etched on the outside of the barrel. Finally, the barrels are Parkerized for one hour. Before this operation is performed, however, the breech end is covered with a cap that fits into the chamber and a plug is inserted in the muzzle end to prevent the Parkerizing material from getting on the internal surfaces of the barrel.

This completes the machining of the Bofors gun barrels, except for the attachment of several accessories in the assembly department.

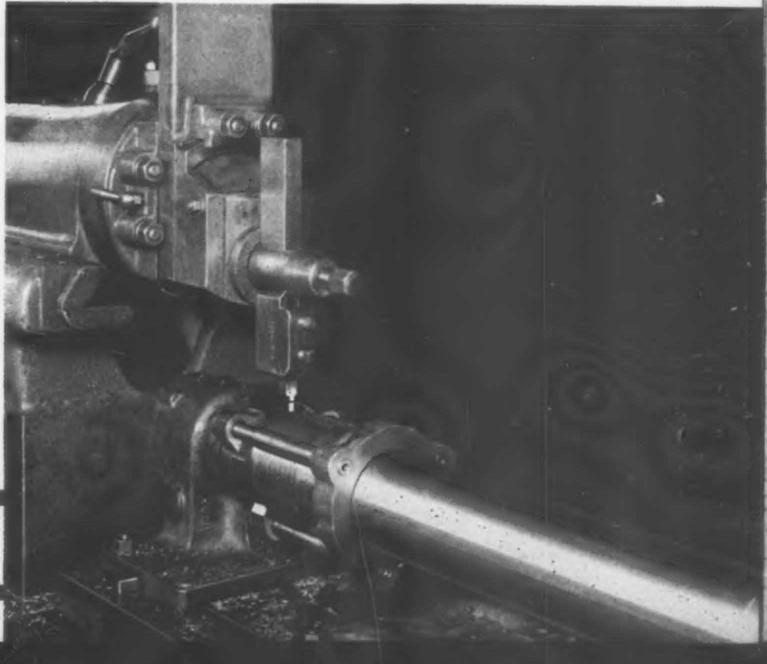


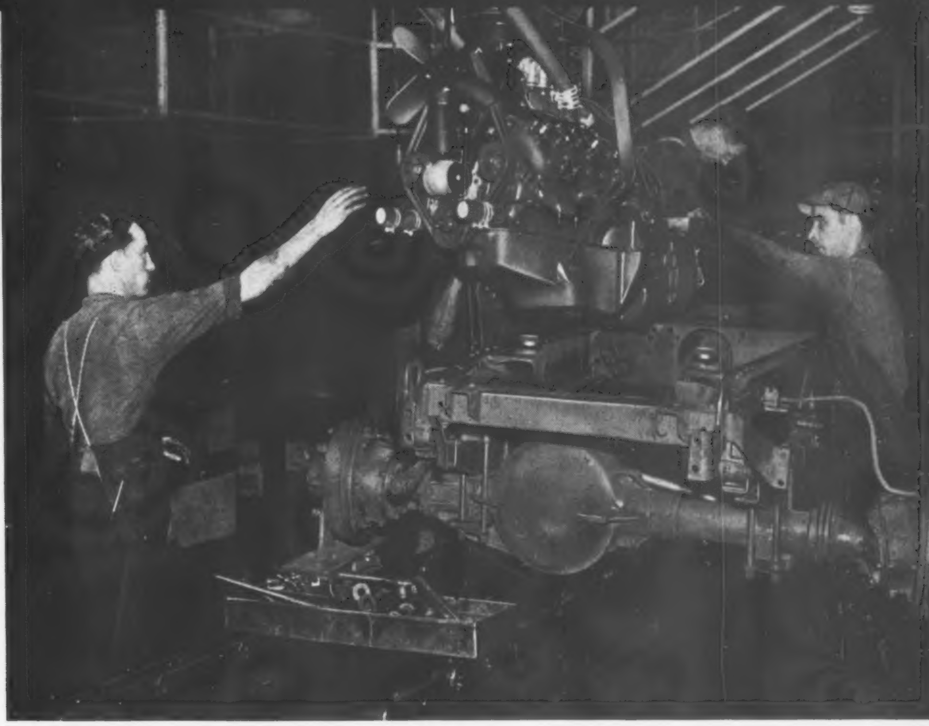
Fig. 11. Bertram Shaper Used for Cutting away Portions of the Thread on the Breech End of the Barrel to Permit Quick Assembly of the Barrel to the Breech Ring

Ford of Canada's Part IN FIGHTING THE WAR

TRUCKS of various descriptions for the armies of the different countries that make up the British Empire roll off the assembly lines of the Ford Motor Co. of Canada, Ltd., Windsor, Ontario, in such large numbers as to indicate that this concern is contributing to the fullest extent of its resources toward a victorious conclusion of the war. Four hundred army trucks are being turned out a day, although not all of them leave the plant fully assembled, thousands of trucks being shipped overseas crated as sub-assembled units for final assembly in Australia, South Africa, and elsewhere. The illustration below shows about one day's output.

The manufacturing operations in this plant have been stepped up to about 125 per cent of normal rates, considerably more than 50 per cent of the production consisting of army trucks. In addition, by January 1, 1941, the company will be turning out every week a substantial number of universal

Fig. 1. Along the Assembly Line that is Turning out Trucks of Various Types for the British Armies



gun carriers, which are light tanks equipped with machine guns. The various types of trucks include eight-hundredweight trucks with a two-wheel drive, which are used for carrying light stores, personnel, and wireless sets; fifteen-hundredweight trucks for carrying heavier loads, and for use as anti-aircraft gun tractors, water tank carriers, etc.; thirty-hundredweight trucks, with a four-wheel or "quad" drive, intended for carrying still heavier loads; and three-ton trucks, with either four or six wheels, intended for transporting heavy loads, wrecking equipment, work shops, etc. Ambulances, regular passenger cars, and station wagons especially fitted out and painted to suit military needs complete the range of equipment being built for the British armies.

Various views along the assembly lines are shown in Figs. 1 to 3, inclusive. The motor, transmissions, axles, and other units are sub-assembled, as in conventional automotive practice, and delivered by overhead conveyors to the proper stations along the final assembly lines. The truck frames are lowered upside down, and placed lengthwise on one end of a conveyor, and as they are carried along, the front and rear axles are attached. Then the frame is turned over and transferred to the final assembly line where the motor, transmission, "quad" drive members, wheels, fenders, cab, and so on are added. The truck bodies are built by other concerns and are added to the trucks after they leave the final assembly line.

The parts that make up the entire engine, and many other parts, are the same as those used in the regular passenger automobiles and trucks built by the company, and, therefore, it was not necessary to provide new tooling for their manufacture. There

Fig. 2. The Army Trucks Approach the End of the Final Assembly Line, with the Mounting of the Wheels and Small Accessories at the Front End

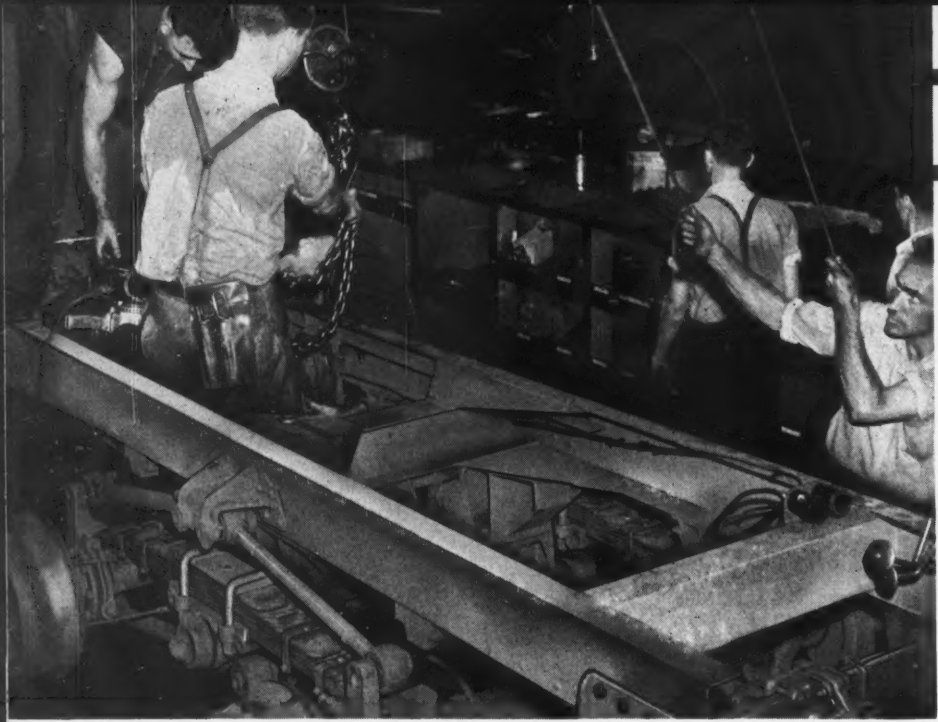
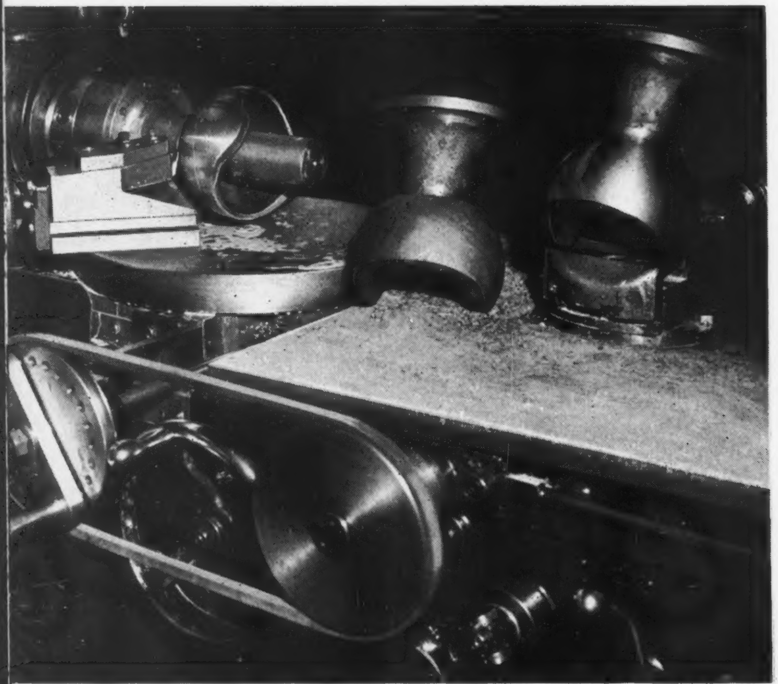


Fig. 3. Another View along the Assembly Line, Showing a Typical Chassis Construction for an Army Truck of the Six-wheel Type



are a considerable number of other parts, however, that did necessitate new methods and machine set-ups. Typical operations included in the latter classification will be described in this article.

Each "quad" drive has two steering-end ball sockets of the "egg cup" design seen at the right in Fig. 4. The spherical surface of these parts is rough- and finish-turned in two lathes provided with special equipment, the illustration showing a Monarch lathe used for taking the finishing cut. In this operation, as well as in the preceding roughing operation, the tool-rest is mounted on a circular table which is revolved to carry the cutter around the work in the desired arc. The cutter can be adjusted in and out relative to the work for setting it to the desired radius from the work-center or for changing the depth of cut.

The table is revolved at the desired speed for feeding the cutter around the spherical work surface by the engagement of a large diameter worm-wheel on the under side of the table with a worm mounted on a shaft that extends to the front of the lathe. A grooved pulley on this shaft is driven by

Fig. 4. (Center) Steering-end Ball Sockets for the "Quad" Drive are Spherically Turned on Specially Equipped Lathes

Fig. 5. (Bottom) A Burnishing Operation is Performed to Obtain the Desired Smoothness on the External "Egg Cup" Surface of Steering-end Ball Sockets

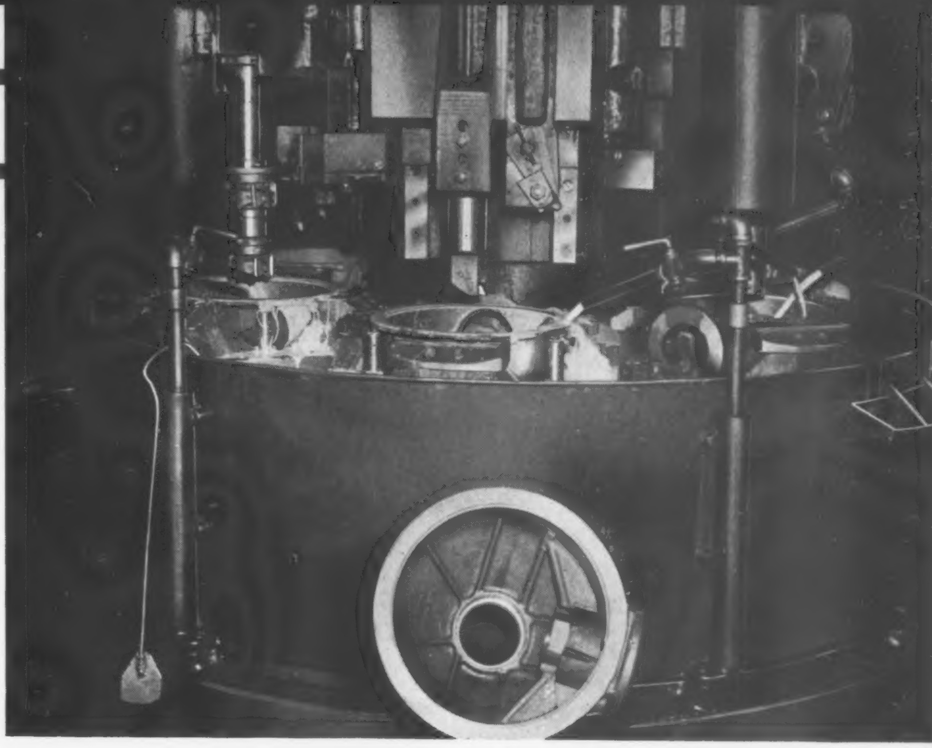


Fig. 6. Mult-Au-Matic Tooled up for Machining Rear-axle Housing Bells and Gear Housings for Winches Provided on Some Army Trucks

belt from a pulley mounted at the front end of the regular cross-slide screw of the machine. The cross-slide screw is driven from the saddle gearing in the usual manner, but the nut of the compound rest is disconnected from the cross-slide screw, so that the compound rest remains idle. Likewise, the lathe carriage remains locked in one position.

By lifting a spring plunger on the handle at the front of the driven pulley on the worm-shaft that drives the swiveling table, the worm-shaft can be disconnected from the pulley and the remainder of the drive. The circular tool-carrying table can then be turned by hand for convenience in setting up the tool.

About 3/16 inch of stock is removed from the spherical surface by Carboloy tools in the rough- and finish-turning operations, the castings having a hardness of about 300 Brinell and the nominal diameter of the spherical surface being 6 3/4 inches. Prior to the turning of the "egg cup," the castings are bored and faced on the opposite end, so that they can be accurately located on the head-stock fixture in machining the spherical surface.

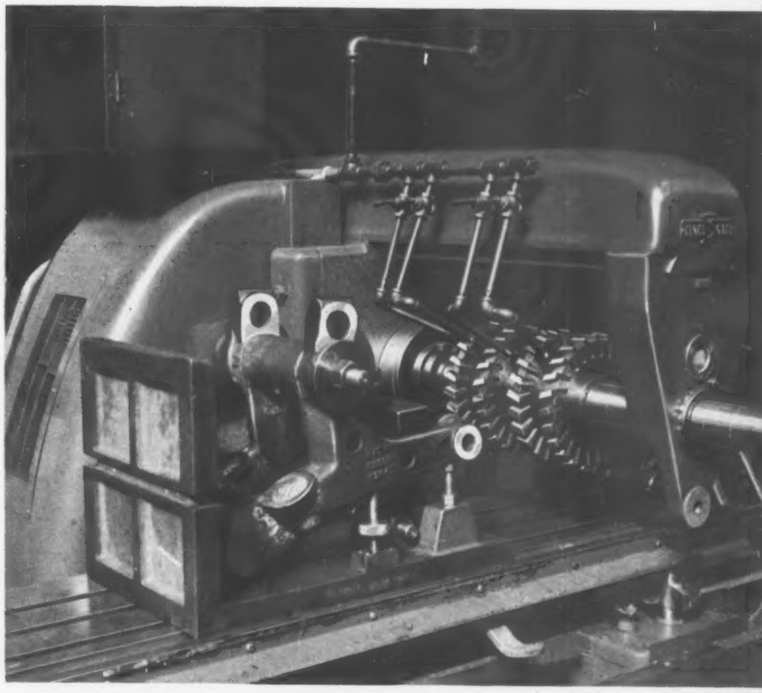


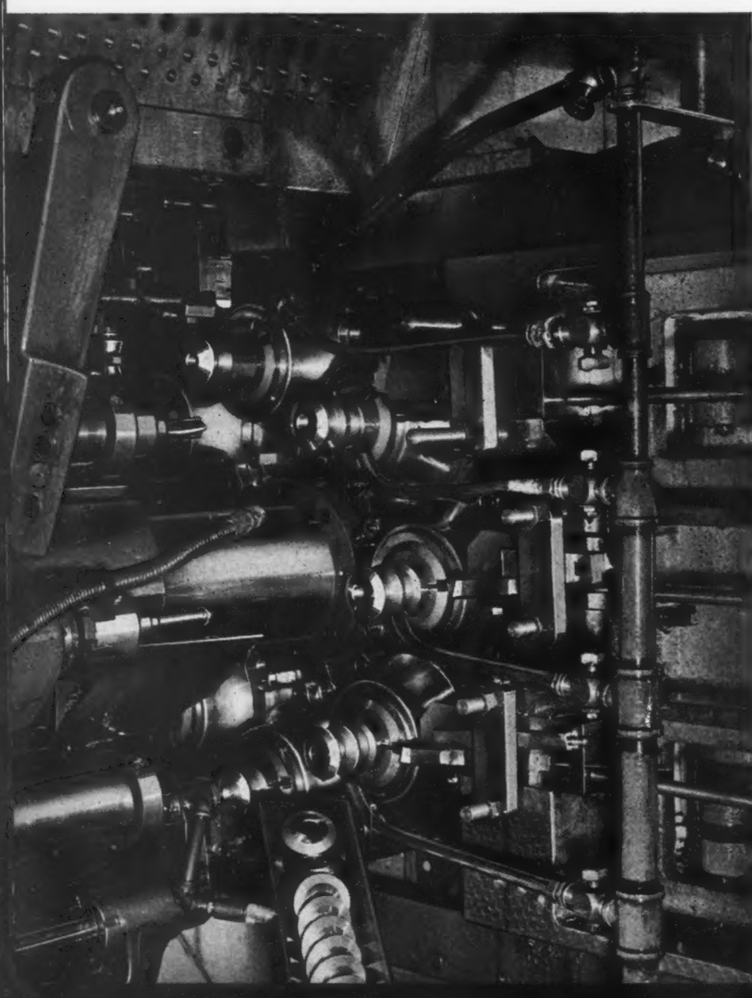
Fig. 7. (Center) Milling Operation on a Front Bogie Bracket, in which Use is Made of a Fixture that is Employed for Three Different Operations

Fig. 8. (Bottom) Milling Two Inner Faces on the Opposite End of the Front Bogie Bracket from that being Milled in Fig. 7

Fig. 9. Milling Four Surfaces Accurately to a Square Cross-section by Employing a Vertical-spindle Milling Machine Equipped with an Indexing Fixture

HOW CANADA MAKES MUNITIONS

Fig. 10. Tooling Provided on a Conomatic which Produces Pinion Blanks and Burnishes the Hole and an External Spherical Surface on the Blanks



The spherical "egg cup" is burnished, after finish-turning, in the machine shown in Fig. 5, which is also an engine lathe equipped with a special swiveling table on which the burnishing roll is mounted. This table is also fitted with a large-diameter worm-wheel, which is driven by a worm on a shaft that, in turn, is driven through pulleys and a belt from the saddle feed-screw.

The burnishing roll can be adjusted so as to exert sufficient pressure on the work to compress the metal surface from 0.002 to 0.005 inch, and thus obtain a cold-worked surface with a high polish. The roll is fed from right to left along the spherical surface until a dog on the table comes in contact with an electric snap switch on the stationary table base. This causes the table to travel in the reverse direction and carry the burnishing roll back to the starting position, in contact with the work. The burnishing roll is 2 1/2 inches in diameter, and has a burnishing surface about 1/4 inch wide. It is made of high-speed steel, and has a hardness of between 54 and 60 on the Rockwell C scale. It has lasted for more than 25,000 pieces, and is still in first-class condition.

Bullard Mult-Au-Matics are employed for machining rear-axle housing bells of the construction seen at the front of the machine in Fig. 6. The same part, with the small-diameter end cut off for a length of about 6 inches, is also used as a gear housing on the winch drives that are provided on six-wheel army trucks equipped for pulling gun carriages. The ends are cut off for the winch parts, however, at the completion of most of the machining operations, so as to permit the parts to go through the regular manufacturing procedure followed on the pieces that are to be used as rear-axle housing bells.

In the first Mult-Au-Matic operation on the housing bells, the parts are loaded in the chucks with the large end extending upward, as seen in Fig. 6. In the first working station of the machine, a down-feed tool-head is employed for rough-boring the tube bearing and cleaning up the inside of the large end of the housing for gear clearance. In the second working station, a tool-head that is fed cross-wise, rough-machines the large-diameter mounting face and the top of the pinion outboard bearing. The third working station, which is seen at the right in the illustration, is provided with a down-feed head equipped with tools that perform semi finish-boring operations on the tube bearing and turn the mounting face pilot.

In the fourth working station, the tool-head feeds crosswise for facing the bottom bearing seat and the mounting face. Finally, in the fifth working station, the tube bore and a roller-bearing diameter are reamed by means of two tools on the floating holder seen at the left in the illustration. The work chucks are revolved at different speeds in the various stations, so as to obtain cutting speeds consistent with the types of cuts being taken in the individual stations.

The same parts are machined on the pinion mounting surfaces in a second Mult-Au-Matic. Carboloy cutters are used in taking all the cuts on both machines.

A front bogie bracket is being milled on two inside and two outside boss faces by four inserted-blade cutters, 10 inches in diameter, in the operation illustrated in Fig. 7. The machine in which this operation is performed is a Cincinnati Hydromatic milling machine. The casting is held in a fixture of such a design that it can be used for three different operations on the same part. In these operations, the fixture is set up on two different faces. The machine table is reversed automatically when it comes in contact with a stop.

Two inside faces are milled on the opposite end of the same part in the operation illustrated in Fig. 8, which is also performed on a Cincinnati Hydromatic milling machine. Cutters of the inserted-blade type, 12 inches in diameter, are provided on the machine spindle.

In Fig. 9 is shown an operation on a Cincinnati vertical-spindle milling machine, in which four sides of a rear bogie bracket are milled to a square cross-section, so as to form mounting surfaces. The four faces must be closely parallel and at right angles to each other, and must be to the specified width in both cross-sectional directions within 0.001 inch. These four faces are successively milled by indexing the work fixture and feeding the work crosswise in relation to the cutter. It is necessary to return the table to the forward position after each surface has been milled, in order to permit the work to clear the cutter as it is indexed into position for milling the next side. Slots are provided in the index-plate at the left-hand end of the fixture to enable the work to be accurately located in the four indexed positions.

Two surfaces, 6 inches wide each, are ground on rear-axle shaft housing tubes by the Cincinnati centerless grinding machine shown in Fig. 11. A rough forging and a tube that has gone through

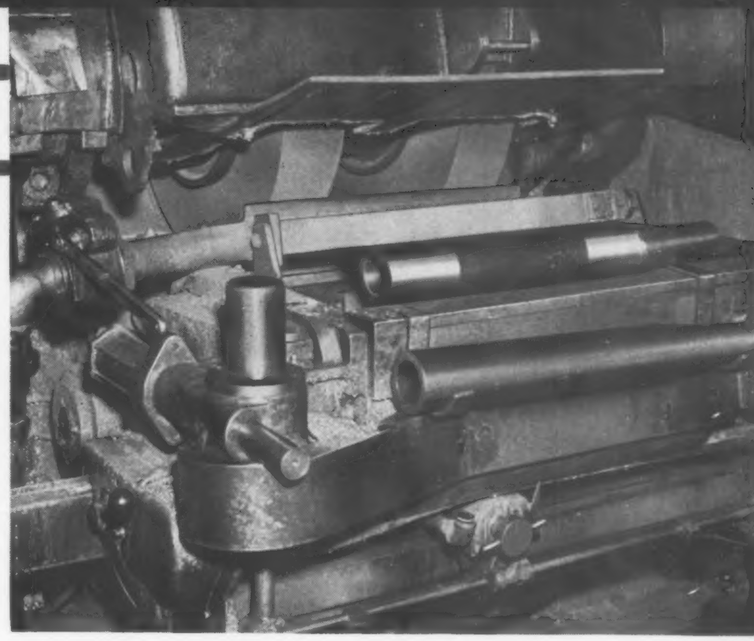


Fig. 11. Centerless Grinding Machine Employed in Finishing Two Surfaces, Each 6 Inches in Width, around Rear-axle Shaft Housing Tubes

NOW CANADA MAKES MUNITIONS

Fig. 12. One of Two Seam Welders Used in the Manufacture of Gasoline Tanks for the Army Trucks. The Machine Shown Welds the End Pieces around all Four Sides

this operation are seen lying at the front of the machine. In this operation, the tube to be ground is loaded on the table in such a manner that it is free to revolve with the grinding and feeding wheels. The table is moved into the grinding position by hydraulic power, and is similarly returned to the front of the machine at the end of the grinding cycle, which lasts 1 1/2 minutes. From 0.060 to 0.065 inch of stock on the diameter is ground off in bringing the finished surfaces to size within a tolerance of 0.002 inch.

In Fig. 10 is shown an eight-spindle Conomatic of 2 5/8 inches capacity engaged in producing bevel pinion blanks from bar stock at the rate of one every thirty-seven seconds. One of the features of this equipment is that, in addition to the more or less standard tools, there are two tools for burnishing a spherical surface on the back of the pinion blanks, as may be seen from the examples sliding down the chute at the front of the machine, and for burnishing a hole that extends through the blanks.

The tool that burnishes the spherical surface is mounted on the main slide in the top position, as illustrated, and consists of two cone-shaped rolls which are advanced against the end of the work under sufficient pressure to compress the metal on the pinion blank being formed. The two cone-shaped rolls are free to revolve with the work. The tool for burnishing the hole through the pinion may be seen on the main slide in the central front position.

In addition to the burnishing steps, each pinion blank is drilled three times, reamed, and chamfered by tools mounted in the various positions around the main slide, and is turned, faced, and cut off by tools on the front and rear cross-slides. The bar stock is 2 1/2 inches in diameter. Gages are applied at this machine for checking the curvature of the burnished spherical surface and the distance from the highest point on this surface to the opposite face of the gear.

A considerable number of press operations are performed in stamping and forming sheet metal into cab roofs, fenders, gasoline tanks, etc. In Fig. 13 is shown a close-up view of the punch and die used to form the roof panels from blanks of 18-gage steel previously cut to the required outline. The sheet metal is held by a conventional type of blank-holder while the punch descends and draws the roof to a depth of approximately 6 inches. The machine used is a Toledo double-action press of about 800 tons capacity.

After the sheet of terne plate that forms the four sides af gasoline tanks and pieces of the same material for the ends have been blanked and formed, they are tack-welded together by the use of a spot-welder, and then delivered to a seam welder, which welds the seam that runs the full length of each tank at the point where the two edges of the piece that forms the four sides come together. Then the tank is passed to the seam welder shown in Fig. 12, where the end pieces are welded all around to the four tank sides. The two circular electrodes on this machine are friction-driven by small knurled rollers located at either the top or bottom of the electrodes, the welding speed being 140 inches a minute. Close control of the welding on the seam welders is afforded by a General Electric timer equipped with Thyratron vacuum tubes.

Fig. 13. Die Equipment Employed for Drawing Cab Roofs for Army Trucks

Engineering News Flashes

Giant Rubber Tires Produced in Huge Molds

Seven months of engineering and development work conducted by the Firestone Tire & Rubber Co., Akron, Ohio, with the cooperation of steel and aluminum foundries, have preceded the starting of production on what is claimed to be the world's largest regularly made rubber tires. These tires are close to 10 feet in diameter and are made in a mold, which, with bead rings, weighs 63,000 pounds. This mold is made from six separate castings, partly of steel and partly of aluminum. The tires made in this mold will be used on earth-moving equipment. Each tire weighs over 3600 pounds and has a carrying capacity of 27 1/2 tons.

Newly Developed Gas Protects Steel While Heating for Hardening

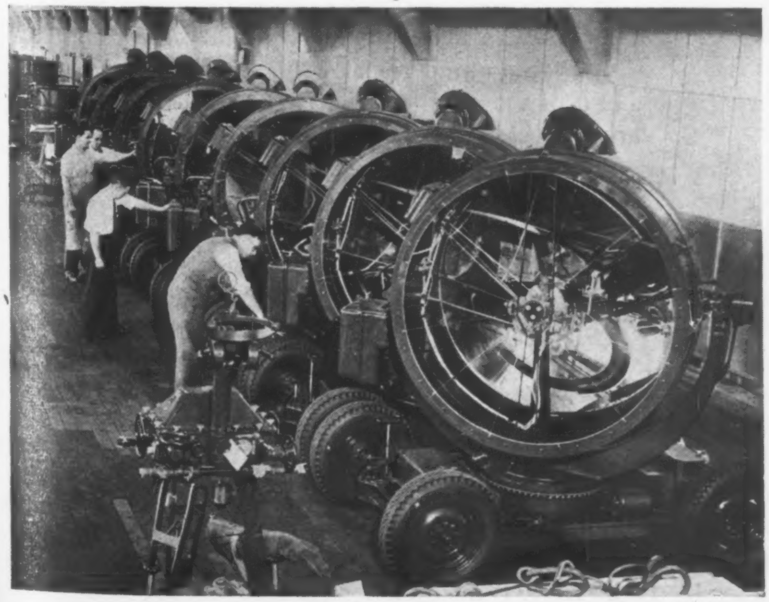
At the recent National Metals Congress in Cleveland, J. R. Gier, research engineer of the Westinghouse Electric & Mfg. Co., explained how the control of the carbon content of "Endogas," a newly developed gas mixture, makes it possible to protect the outside of steel while it is being heated for hardening. The "Endogas" atmosphere acts as a blanket for products such as gears, springs, bearings, and metal-cutting tools while being heated, and prevents decarburization during the process. This development provides an inexpensive atmosphere that prevents the burning, scaling, and softening of steel surfaces during heat-treatment at temperatures as high as 1500 to 2300 degrees F. By varying the amount of carbon in the mixture, the composition of "Endogas" can be adjusted to correspond to the carbon content of any steel.

"Endogas" is made by mixing air with natural gas or other inexpensive fuel gas, and heating the mixture in an electrically heated chamber. By regulating the amount of gas and air entering the chamber, the proper amount of carbon can be procured in the gas. A furnace atmosphere that contains the right amount of carbon has been found to be the best means of preventing decarburization of the surface layers of steel.

Reinforcing Tape Used to Improve Plastic Packing

A non-frictional, vulcanized tape is used to reinforce the "Super-Seal" plastic packing produced by the Crane Packing Co., Chicago, Ill., in place of the old frictional, woven-cotton jacket. The tape-back reinforcement, which is vulcanized to the outer surface of the composition, makes the new packing extremely pliable, enabling it to be bent around small-diameter rods and shafts without fracturing or cracking.

The packing is a dry-graphitized plastic material made from long-fiber asbestos, anti-frictional metal particles, and special binders. There are no oils which can be driven off by heat or pressure, and the packing flows easily under gland adjustment. It is suitable for centrifugal and rotary service, such as centrifugal feed pumps, low-pressure steam rods, valve stems, rotary pumps, expansion joints, and similar applications.



Giant Searchlights Built in the General Electric Co.'s Schenectady Plant for National Defense Purposes. Each Searchlight is 60 Inches in Diameter and of 800,000,000 Candlepower. It has been Possible during Tests of These Searchlights to Read a Newspaper in Troy, N. Y., Twelve Miles from Schenectady, by the Light of These Units. Similar Searchlights are being Used by the British in the Defense of London

EDITORIAL COMMENT

At this time, when we are entering upon a new year, it is well to consider some of the chief problems that face the United States as an industrial nation. One of these problems is that of coordinating Government and business in such a manner that industry may return to a policy of expansion, with the attendant increase in employment. Obviously, the industries directly concerned with the Defense Program have had to expand during the past year; but there are many industries that are neither directly nor indirectly concerned with armament manufacture; to these such coordination is a necessity if they are to resume normal activity.

Now is the Time for the Administration to Cooperate

According to estimates made some time ago by the National Industrial Conference Board, there would have been about one hundred billion dollars more output of durable goods and construction work during the nine-year period ending 1939 if production in the industries had proceeded at the same rate as during the preceding nine years. To make up only half of this accumulated deficiency would require the labor of millions of men for many years. Merely to regain and maintain the standard of living that this country had reached ten years ago, as measured by per capita production of consumer goods, would necessitate the operation of our consumer-goods factories during the next ten years at an average rate of activity far higher than this country has ever known. There would be jobs for all willing and able to work, and there would even be a severe labor shortage, especially since these consumer goods would be produced concurrently with the Defense Program requirements.

This is, therefore, an opportune time to ask that the Administration remove the obstacles it has placed in the way of industry, so that we may regain the standard of living that this country knew ten years ago. If this were done, the theory of permanent unemployment now accepted in many governmental circles would no longer need to be seriously considered.

Obstacles Placed in the Way of Industry Must be Removed

The industries connected with the Armament Program have shown that they want to go ahead, that they are ready to go ahead, and that they are able to go ahead. Other industries are just as eager to progress; but industry's ability to go ahead will continue to be throttled if there is no change in the punitive methods of taxation now applied, and if the investment of new capital is discouraged by governmental policies. The greatest need of this country is not relief, but an expansion of non-war industries to secure additional production, greater employment, and an improved standard of living.

It is merely to reiterate a well-known fact, evident to every impartial observer, that the policies pursued by the Administration during the last seven years have not brought permanent employment and prosperity to the great mass of the people. Now that campaigns and elections are over and we can settle down to consider our problems in a matter-of-fact manner, it is time to recognize that it is only through productive work that the well-being of a nation can be assured. Employment and prosperity in the United States have been created in the past by industry, not by Government. Employment can be assured in the future only if industry is not hampered in its constructive work; thus only can the nation again move toward the goal of a higher standard of living and of a security procured not through the medium of a benevolent Government, but by the self-assurance of men and women able to stand on their own feet.

Industry is the Real Creator of Employment

In these serious times, national unity of purpose and action is necessary. It is important that all of us should stand back of the Administration; but it is still more important that the Administration should stand back of us.

* * *

Work, not words, will preserve the nation. We could live without words, but not without work. Work gets food. Work builds homes. Work erects factories. Work builds protection against the enemy. Work builds character in the worker. Work builds a nation. Unless we work now to a purpose, we may not be free to talk later. Unless we work now as free men, we may work soon as ordered. Other peoples were not warned in time. For us there still is time—if we work.—*A. W. Robertson, Chairman, Westinghouse Electric & Mfg. Co.*

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Precision Variable-Speed Mechanism Employed in Oilgear Drive

Fluid-power variable-speed drives designed to give precisely the driving speed desired, regardless of fluctuations in the speed of the drive to the pump end of the unit resulting from variations in the load, oil temperature, running fits, or power-line currents, were described on page 439 of February, 1939, MACHINERY.

These precision variable-speed drives, developed by the Oilgear Co., Milwaukee, Wis., comprise a standard Oilgear fluid-power transmission with a Micro Servo-Motor stroke control cylinder which adjusts the pump stroke to give exactly the required hydraulic motor speed. Oil is admitted to the control cylinder by a pilot valve, actuated by a small differential unit which continuously compares the hydraulic motor speed with an accurate time-measuring unit or with the speed of any desired master unit.

One of the Oilgear units, when driven by an ordinary induction motor or lineshaft, will drive its load at any desired speed, either constant, adjustable, or continuously varying between zero and maximum.

The mechanism, which maintains the speeds within 1/4 per cent of the desired values, is shown in Fig. 1 equipped with a small synchronous or Selsyn motor *M*, which serves as the accurate time-measuring unit. In cases where the frequency error in the power current supply available for motor *M* is as much as 0.3 per cent and a closer control of speed is desired, the pendulum type precision control shown in Fig. 2 may be used. In this mechanism, pendulum *P* takes the place of motor *M* shown in Fig. 1.

The essential principle of the differential time precision control, as shown in Figs. 1 and 2, is that the hydraulic motor, driven by the flow of power from its variable-stroke pump, transmits the resulting speed to a differential comparator. This differential also receives a standard or master speed time control from the small synchronous motor *M* (Fig. 1) or the pendulum *P* (Fig. 2) which serve as time control units, or from some other unit such as a roll stand or float roll measuring control. In any case, the differential continuously compares the actual speed with the master speed and translates every discrepancy into exactly the increase or decrease of pump discharge necessary to correct the error.

It should be noted that while the use of a pendulum eliminates frequency error, it also limits the speed at which the comparator acts, and thus results in a slower response. When the master speed disk is driven by a motor, the action of the disk type control is so quick that fluctuations of speed due to ordinary load changes are caught and corrected within about one-tenth of a second. With moderate load fluctuations, such as usually exist in a continuous processing plant, the momentary gov-

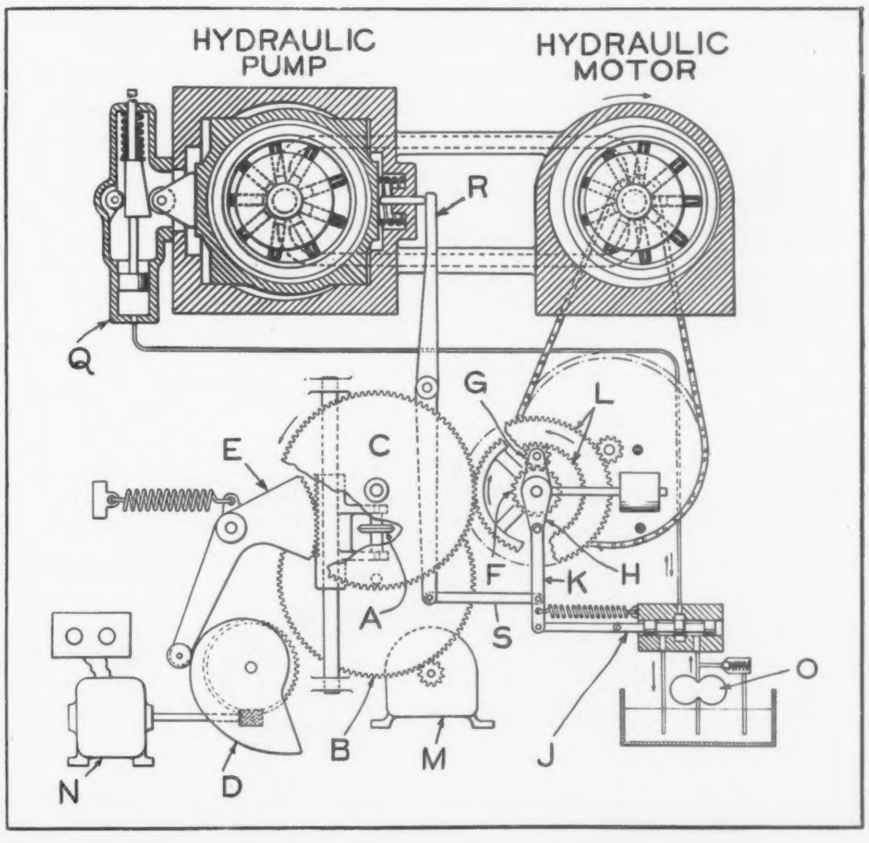


Fig. 1. Fluid Power Drive with Precision Speed Control Employing Synchronous or Selsyn Motor M as Master Speed Unit

erning errors are held within 1/4 of 1 per cent, plus or minus, while the integrated error over a period of time—say, ten seconds or more—is too small to be measurable by a stop-watch.

The differential time disk type control is shown in its usual form in Fig. 1, with a small synchronous or Selsyn motor *M* furnishing the master speed. If *M* is a synchronous motor, the control is by "time," and the speed of the hydraulic motor is given in revolutions per minute. If *M* is a Selsyn motor, it receives its current from a Selsyn generator driven by its master unit, and follows the speed of that master through its entire range from the standstill or stationary position to maximum speed.

The master speed is transmitted to the differential mechanism through the friction-disk ratio-changer, comprising a movable idler disk *A* that is spring-pressed between the driving or master disk *B* and the driven disk *C*. Disk *A* is mounted in a slide-block, and is adjustable by push-button control motor *N* or by a manual or float-roll control through cam *D* and segment *E*.

The master speed, as modified by the ratio-changer, is transmitted by gear teeth in the edge of disk *C* to the sun pinion *F*, the first leg of the differential comparator already mentioned. Planet gear *G* is mounted on a radial valve actuating crank *H* (the third leg of the differential) which, in turn, actuates pilot valve *J* through floating lever *K*. Planet gear *G* also meshes with an internal ring gear *L* which is exactly twice the diameter of sun pinion *F*.

Any movement of the pilot valve resulting from movement of the axis of the planet gear and crank *H* changes the pump stroke and hydraulic motor speed. To hold pilot valve *J* stationary, ring gear *L* (the second leg of the differential) must be driven by the hydraulic motor at exactly one-half the standard speed of gear *F*. Any discrepancy will result in a slight movement of valve *J*, permitting oil from gear pump *O* to enter the pump-stroke changing cylinder *Q*, and thus increase the pump discharge, or permitting oil to escape from *Q*, which will reduce the pump discharge. When the change in pump discharge has corrected the motor speed, so that it again balances the speed of the differential gears, the pilot valve will resume its neutral position.

An essential part of the mechanism is the follow-up lever *R* which responds to the movement of the pump slide-block, and by means of link *S*, closes the pilot valve as soon as the required correction has been made, thus preventing the so-called "hunting" action. As the disks *A*, *B*, and *C* are made of hardened steel, are accurately ground, and transmit no appreciable power, they show little or no wear after long service. This is true even when the speed is not changed and idler disk *A* runs in one location continuously.

A characteristic feature of the drive described is that it cannot be overhauled by a decelerating inertia load, so that winders and unwinders for paper machines, super-calenders, printing presses, textiles, strip and foil, etc., driven by the differential time controls will automatically start and stop heavy rolls of material without sag or added strain in the web. By means of the precise speed adjustment of the disk control, two or more rolls of paper or foil can be unwound from rolls of different diameter at identical surface speeds and at uniform tensions, and laid together for splicing or lamination.

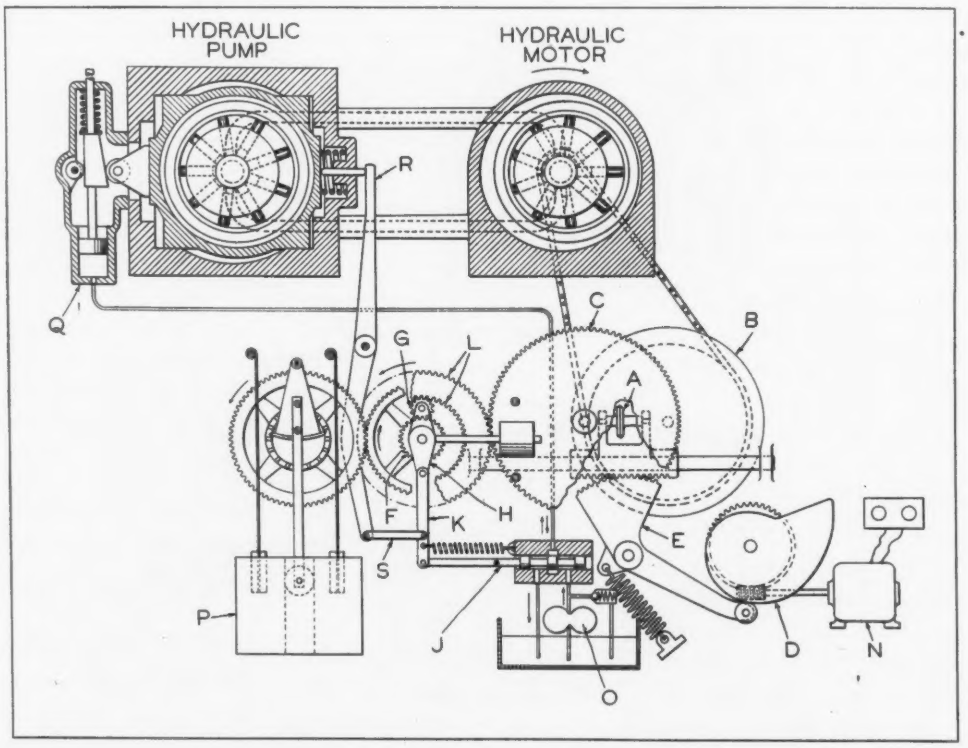
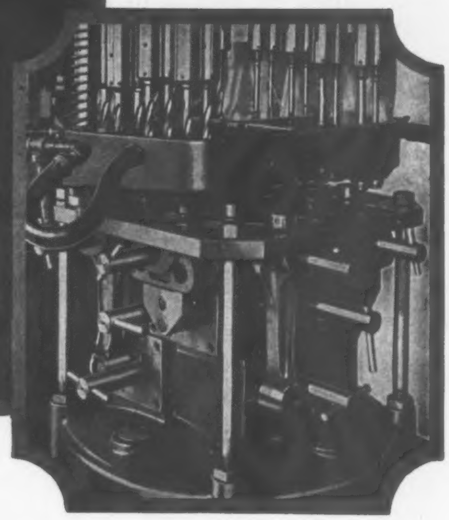


Fig. 2. Drive Similar to One Shown in Fig. 1, Except that Pendulum P Serves as Master Timing Unit in Place of Motor M and Ratio-changing Disks are Moved to Hydraulic Motor Side of the Differential

* * *

The seventh edition of "Standards for the Pump Industry" has just been published by the Hydraulic Institute, 90 West St., New York City. These standards were originally published in 1937. Copies can be obtained from the Hydraulic Institute. The price is $1.25 per copy, delivered anywhere in the United States.

Design of Tools and Fixtures



Clamping Devices Used on Fixtures for Gun Parts

By FRANK HARTLEY

Four clamping devices that are typical of those used on fixtures for gun parts and that represent features of interest selected from complete designs are shown in the accompanying illustrations.

An edge clamping mechanism with a spring-finger hold-down and locator for clamping the work shown at *X* in Fig. 1 permits milling the top of work. One end of the holding fixture is indicated at *A*. The work *X* is held against a stop in another portion of the fixture by means of the spring finger *C* which pivots about the pin *D* as a fulcrum, thereby holding the work down against the surface *E*. Clamping along the front edge of the work is accomplished by means of the lever *F* which tightens the clamp plate *G*, thereby holding the work against the lug *H*.

The particular problem in connection with the design shown in Fig. 2 is to provide a parallel method of clamping over finished surfaces, and at the same time, allow sufficient opening of the clamp to permit a small boss on the work to be slid out of a hole in the upper holding member.

With this in mind, the work *X* is supported on the pad *A* of the fixture base *B*, which is welded to the corner plate *C*. Supported on two guide pins *D*

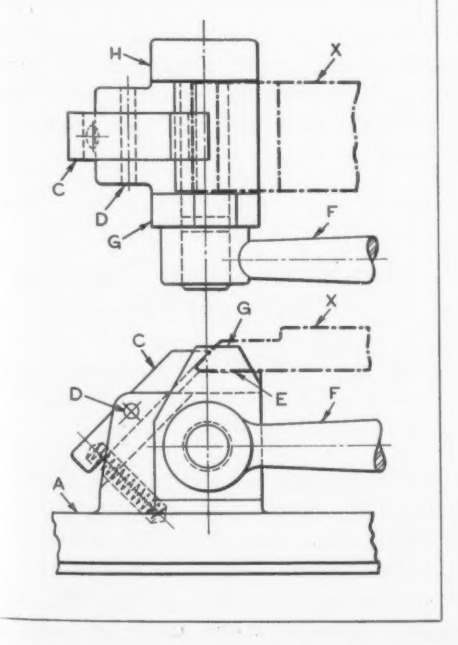


Fig. 1. Fixture Designed to Permit Milling Top of Work

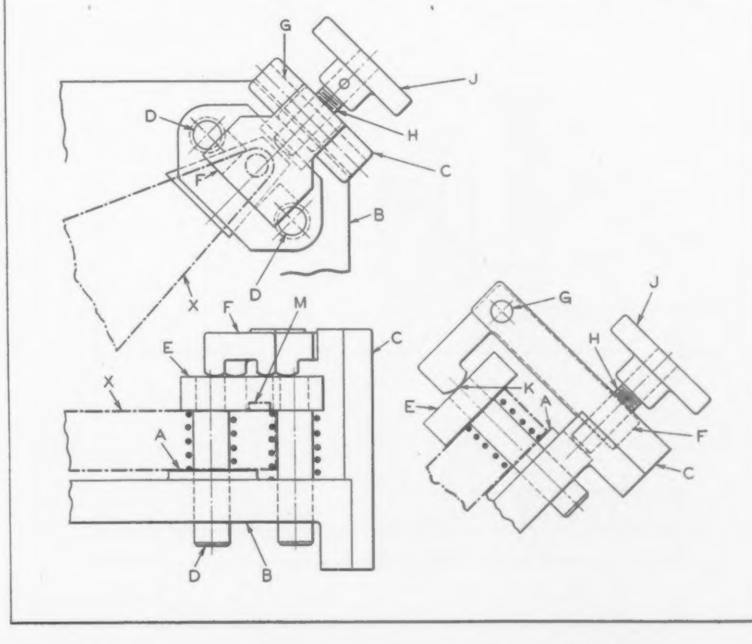


Fig. 2. Work Clamping Device Provided with Clearance for Small Boss

is a movable top plate E, the function of which is to clamp the work against A. The clamping is accomplished by means of the right-angle swinging clamp indicated at F. Clamp F pivots on the hinge-pin G, being actuated by a screw H fitted with a hand-knob J. When the screw is tightened, the clamp pivots at G and the end K forces the top plate E against the work. Springs on the guide pins hold the top plate and clamp up while the work is being removed, and it should be noted that the plate must open a sufficient amount to permit the work to be removed from the left side, with the boss M clear of the hole.

The work clamping method shown in Fig. 3 provides a means whereby the clamp H of a profiling fixture is advanced into position over the work X and tightened down in one movement of a lever. At B on base A is shown the profile form block. A guide pin C traversed along the formed edge of this block causes the cutter D to reproduce the same form on the work. The cutter is shown in two other positions at E and R.

On this fixture, the work is located over two pins F and G. The clamping member consists of a plate H, supported and guided at the left end by a pin J. A cam L is in contact with a cross-groove in the clamping plate, and it is the function of this cam to advance the plate into position over the work. The cam also withdraws the clamp from its position over the work after the milling operation is finished.

Cam L is made as part of the clamping stud N, which is threaded into the base of the fixture. The handle P is used to tighten the stud, while the spring at Q raises the clamp clear of the work when released.

It will be seen that the first action of clamping after putting the work over the pins is to have the cam surface advance the clamp over the work; after this, the continued turning of stud N causes the clamp to be tightened down on the work. Clamping devices of this type can be used to advantage when the sides of the work are finished.

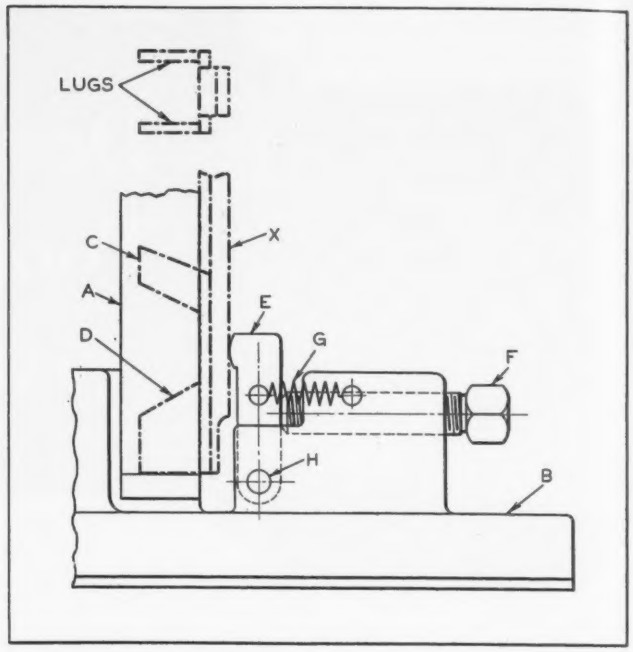


Fig. 4. Fixture with Vertical Swinging Clamp and a Work Retaining Block

A vertically placed swinging clamp mechanism is shown in Fig. 4, the work indicated at X being placed over a retaining block A, held by screws (not shown) to the frame B of the fixture. The projections C and D of the work take the form of four lugs; this gives to it the form of a yoke, as shown in the plan view. After slipping the work in place from the top, clamp E is caused to grip the work securely through the medium of screw F. The tension spring at G holds the clamp E, which is pivoted at H, back against the screw, thus preventing the clamp from swinging to the left to interfere with the placing of the work in the fixture.

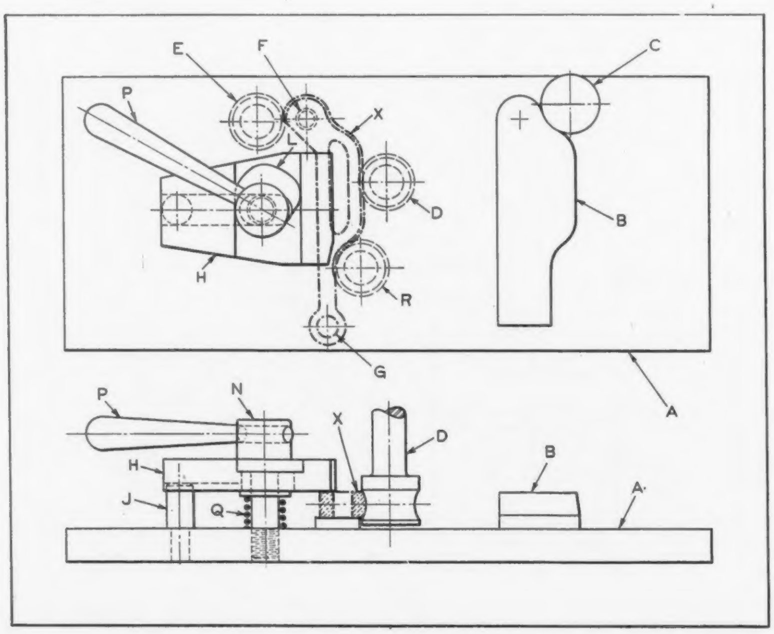


Fig. 3. Profiling Fixture with Clamp that is Moved into Position and Tightened by Single Movement of Lever

Automatic Stock Gage for Inverted Dies

By JOSEPH I. KARASH, Tool Design Dept.
Reliance Electric & Engineering Co.
Cleveland, Ohio

In the operation of a large inclinable blanking press for producing motor laminations, the circular blanks are punched out of a sheet of material which is fed across the face of the die. If no safety screens were used to surround the die set, the operator could extend his hands into the press to lift the ma-

terial over the stop-pin and move it to the next position. From the standpoint of production this would be an efficient method of operation. However, due to the hazard involved, such a method of operation was entirely out of the question.

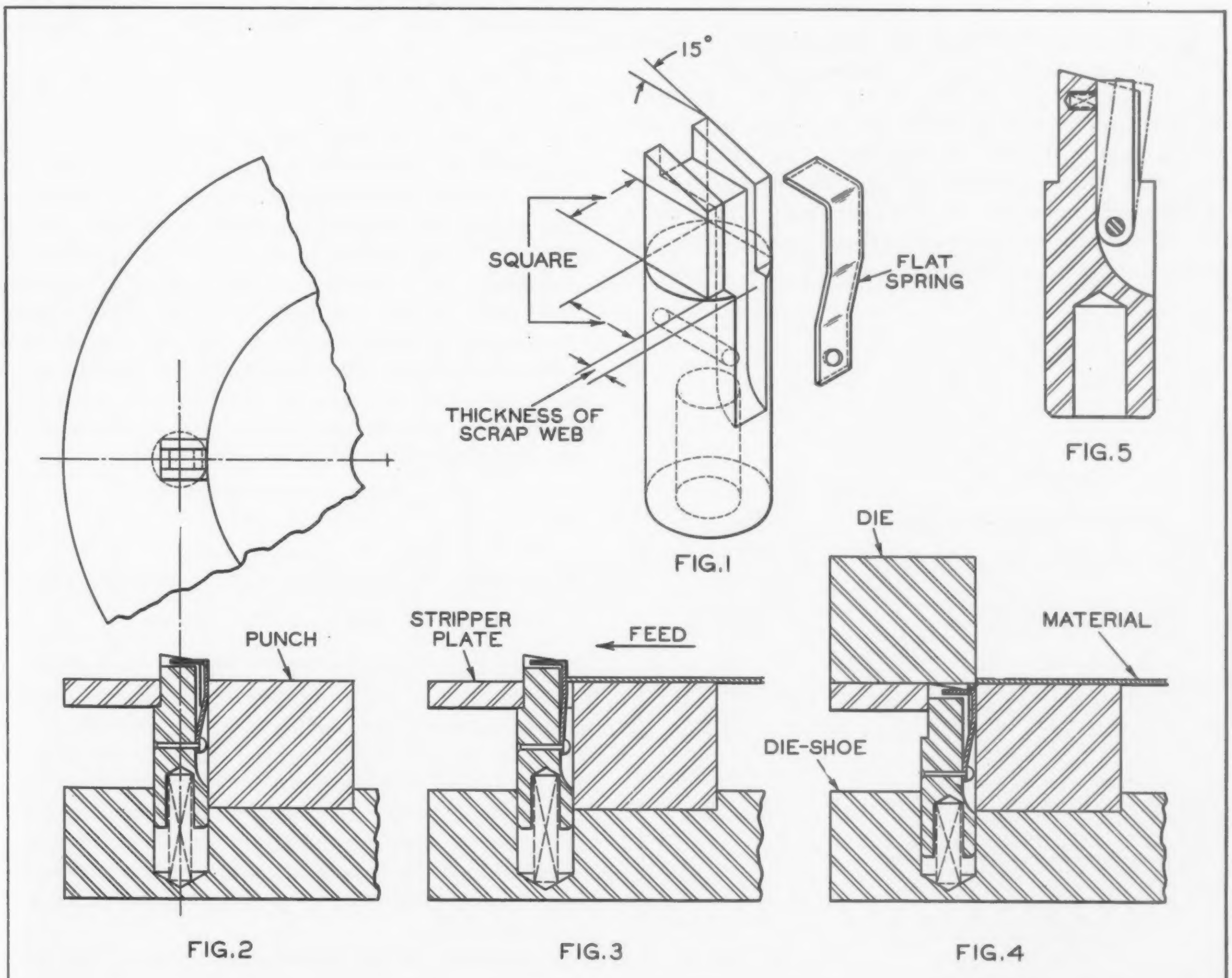
Upon surrounding the die set with protective screens, it was found that the operator could not conveniently hold the material on both sides of the die, due to the size of the die set. In attempting to feed the material from the entrance side of the die, it was found necessary to design an automatic stock stop, so that the operator would not have to lift the web of the scrap over the stop-pin, which was on the far side of the die.

Fig. 1 is an isometric view of the main parts of the automatic stock stop, which consists of the stop-pin and a formed flat spring. The stop-pin is made of 3/4-inch diameter drill rod. A square section is first milled on the end of the pin. The difference in size between the square section and the diameter of the pin determines the size of the scrap web in the material being punched. A 15-degree angle is then cut on the top of the pin, as shown. A slot is next cut across the top and down the side to accommodate the formed flat spring. The pin is completed by drilling the rivet hole and the hole in the bottom for the compression spring.

The automatic stop is applied to the die by drilling a hole in the die-shoe to receive the stop-pin. This hole should be tangent to the edge of the punch. A rectangular hole is then cut in the stripper plate to fit the square section of the stop-pin. After being assembled, the stop can be depressed vertically but cannot rotate.

The operation of the stop will be clear by reference to Figs. 2, 3, and 4. In Fig. 2, the stop is shown in a normal position without the material. In Fig. 3, it is shown with the material in position. It should be noted that the material is not located against the flat spring, but against the square section of the stop-pin, the spring being pushed back into the slot. The flat spring should be thin enough to offer negligible resistance to the forward movement of the material.

In Fig. 4, the stop is shown in the position it occupies at the instant the material is being fractured. The die in the upper member has depressed the stock stop, thus allowing the flat spring to snap under the scrap web. The 15-degree angle on



Views Showing Design and Operation of Automatic Stock Gage for Inverted Dies

the top of the pin provides clearance between the flat spring and the scrap web. As can be readily seen, the scrap web will be lifted by the flat spring when the die opens. The material is then free to be slid to the next position.

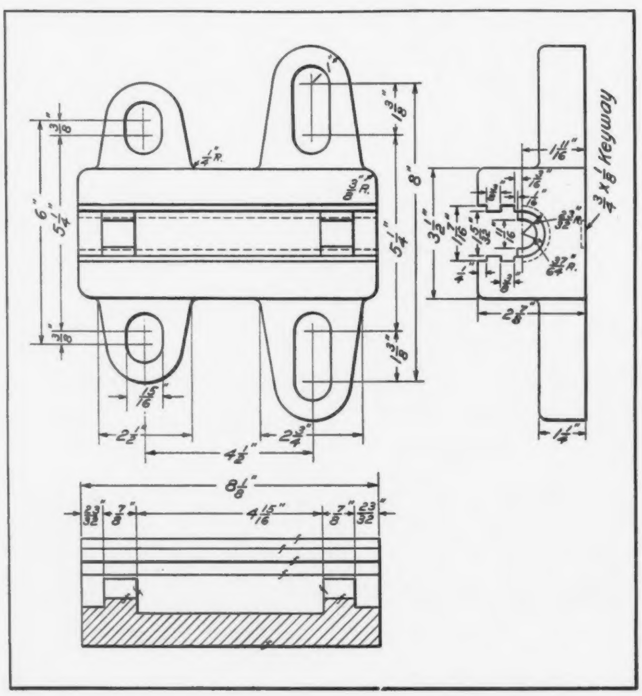
The blank is forced up into the upper die, from which it is ejected at the top of the ram stroke by the stripping action of a knock-out pin. Since the operation is performed in an inclinable press, the blank will fall clear of the die. Though the stock stop was designed for large die operation, it can be used for small inverted dies. The use of the automatic stop enables the operator to feed the stock across the die by constant pressure, as he is not required to lift the material over the stop-pin at every stroke of the ram.

In Fig. 5 is shown another automatic stop-pin which can be used for heavy material. Instead of a flat formed spring, a spring-actuated finger is used to lift the scrap web.

Independent Chuck-Jaw Housing

By MARTIN H. BALL, Watervliet, N. Y.

The independent chuck-jaw housing here illustrated was made to take the chuck jaw and screw of a standard 8-inch Cushman chuck. It was designed for use on the table or faceplate of a vertical boring mill, and on the faceplate of a large lathe, the object being to provide more secure clamping of the work to the faceplate. The difficulty previously experienced from loosening of the standard chuck-jaw housings under the pressure of the cutting tools when used on exceptionally heavy work was eliminated by the additional clamping power provided by the independent chuck jaws.



Chuck Jaw Housing Designed to Take Jaw and Screw of a Standard 8-inch Cushman Chuck

The improved chuck-jaw housing allows ample room for the use of bolts, nuts, and wrenches, and provides for four clamping bolts for each housing instead of the two ordinarily used. The slotted clamping lugs also allow the jaws to be employed with faceplates that are made with either radial or parallel slots.

* * *

Machine and Tool Progress Exhibit in Detroit

Early in December, almost four months prior to the opening of the Machine and Tool Progress Exhibition, which will be held in Detroit March 25 to 29, more than three-fourths of the total available space was reserved. The exhibition is sponsored by the American Society of Tool Engineers, 2567 W. Grand Blvd., Detroit, Mich., and will be held in conjunction with the annual convention of the Society. The basic theme of both the exhibition and convention will be "Education for National Defense."

Modern production equipment and tools available to industry will be shown. Exhibitors have been requested to show their machines, tools, and equipment in operation if possible. In addition to metal-working machines and tools, the exhibits include gages and testing equipment, metal spraying equipment, drafting materials, air-conditioning equipment for factories, alloy castings, blowers, conveyors, hoists, pumps, welding equipment, wrenches and hand tools, paints, oils and greases. A preview will be held March 24 for which special invitations will be sent to leading industrial and government executives, and others interested in equipment for accelerating production.

* * *

Important Chemical Now Manufactured in the United States

It has been announced by the E. I. duPont de Nemours & Co., Wilmington, Del., that domestic manufacture of potassium cyanide, which is employed in steel hardening operations, is now under way in one of the company's plants in the United States. Until now this chemical has been imported, but none of the imported material, it is stated, is available at the present time. In the production undertaken, American raw materials will be used exclusively.

In addition to its importance in the heat-treatment of steel, potassium cyanide is also used in electroplating processes and in engraving and lithography.

MACHINERY'S DATA SHEETS 433 and 434

MACHINERY'S DATA SHEET INDEX—1

February, 1937, to December, 1940, Inclusive

MACHINERY'S Data Sheet No. 433, January, 1941

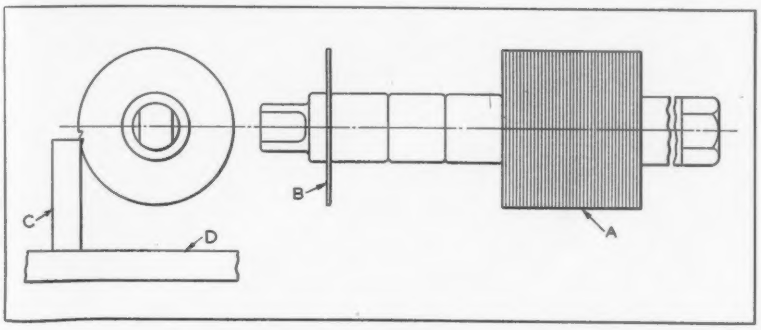
MACHINERY'S DATA SHEET INDEX—2

February, 1937, to December, 1940, Inclusive

MACHINERY'S Data Sheet No. 434, January, 1941

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work



Diagrams Showing Simple Set-up Used for Sharpening Slotting Cutters

Lengthening the Life of High-Speed Steel Screw-Slotting Cutters

Many high-speed steel screw-slotting cutters that are thrown in the scrap box when they have become too dull to cut well could have their life extended by regrinding. In our plant, it has been customary to use slotting cutters of various gages, with 44, 56, and 72 teeth. Recently, however, we standardized on 56-tooth slotting cutters, and are obtaining satisfactory results with them.

A gang of six slotting cutters is used for a certain job. These cutters are quickly changed for a new set when the cutting action falls below par. When enough dull cutters have accumulated to form a pile about 2 1/2 inches wide, they are mounted on one end of a gang arbor, as shown at *A* in the illustration. A new slotting cutter *B* is located against the shoulder at the opposite end of the arbor. The new cutter serves as the indexing guide for the cutters that are to be reground.

With the arbor placed between bench centers, the cutters *A* are lined up with the index cutter *B* by means of a parallel bar *C* of suitable height, placed on the base *D* of the bench centers. The arbor nut is then securely tightened with a wrench to hold the cutters in place. A finger-rest is used with cutter *B* in the conventional manner to index the cutters *A* when grinding the teeth. A 6- by 1/4-inch 60-K alundum grinding wheel is used for the regrinding operation, the face of the wheel being dressed to the correct cutter tooth angle. From 0.005 to 0.007 inch is removed from each tooth by the grinding wheel, only one cut or pass of the wheel being required to obtain sharp edges.

Comparing the original cost of the slotting cutters with the cost of fifteen to twenty resharpening operations, it will be seen that a considerable saving in tool costs is effected.

Aldenville, Mass. JERRY BERARD

* * *

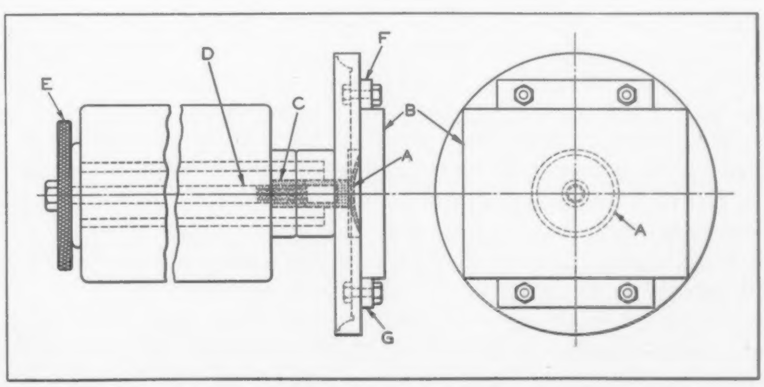
Holding Work on Faceplate with Rubber Suction Cup

The rubber suction cup shown at *A* in the illustration is used in a novel manner for holding a flat rectangular piece of work *B* on the lathe faceplate while grinding the surface with a toolpost grinder. A small lot of the machine-steel plates *B*, each 4 by 3 inches by 1/2 inch, was successfully ground with the aid of this equipment, the opposite sides of the plates being ground flat and parallel with each other.

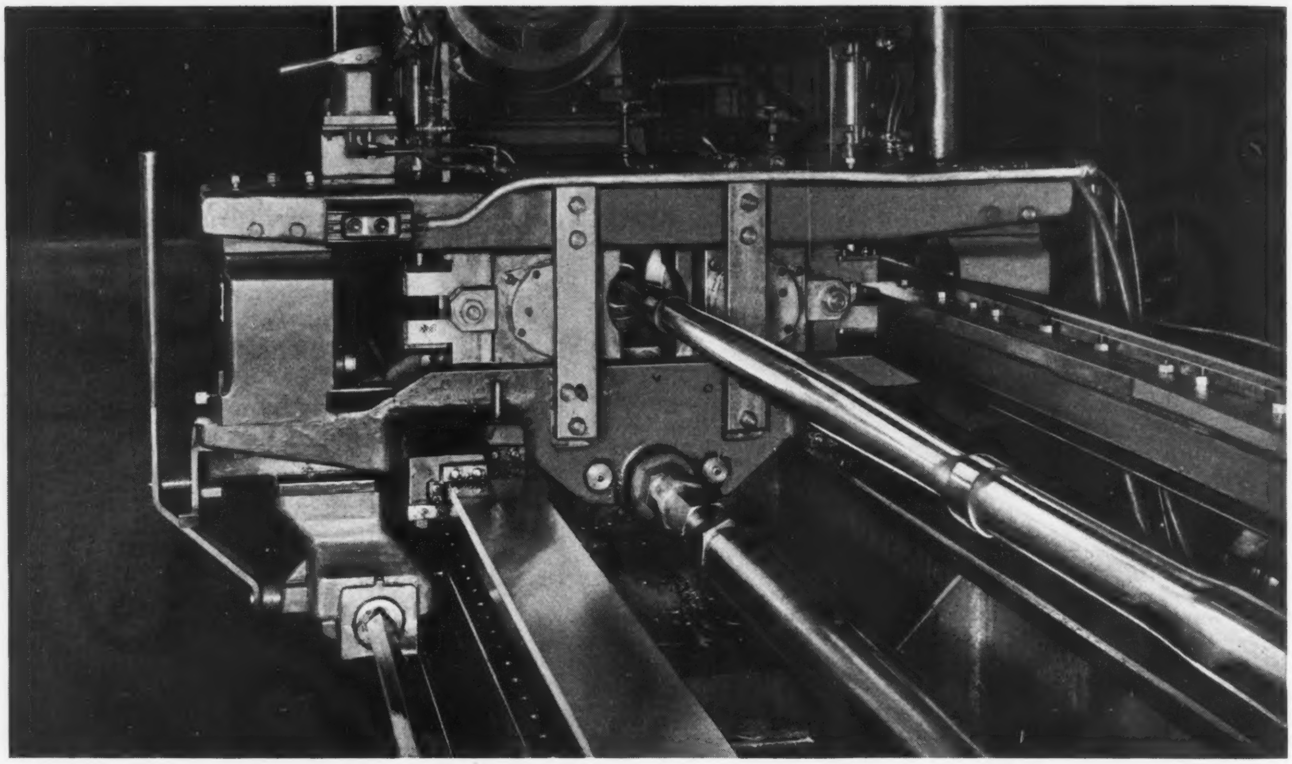
The suction cup is of a kind used for lapping automobile engine valves. A section of the stem was cut off, and an extension steel stem *C* cemented to it. The extension stem was tapped to receive a draw-in rod *D*, which was made from 5/16-inch cold-rolled steel and fitted with a discarded handwheel *E*.

The suction cup will lift about 8 pounds if pressed on a reasonably smooth surface, and will therefore safely hold a piece the size of plate *B*. However, the pull against the faceplate should not be excessive. The faceplate should be previously spot-ground, and the work should be supported by guide bars *F* and *G*. Although the suction cup cannot take the place of a magnetic chuck, it can be used when a magnetic chuck is not available and when non-magnetic material is to be held.

Springfield, Mass. ARMEN TASHJIAN



Set-up Employing Suction Cup A to Hold Piece B against Faceplate



Tubing Shaped to Any Contour by an Entirely New Process

A Remarkable Development which Enables Tubes to be Formed to Any Shape Obtainable on Solid Bars in a Lathe, Except for Shapes Including Sharp Corners or Under-Cuts

STEEL or non-ferrous tubing can be easily formed to practically any regular or irregular outline, including straight, tapered, and rounded sections, by a remarkable development known as the Dewey Process, which is being announced to industry by the Steel & Tubes Division of the Republic Steel Corporation, Cleveland, Ohio. Tubular products such as airplane struts and braces or automobile propeller shafts that must taper from the center to both ends are shaped by means of this process without any press operations and without cutting and welding the tubes. The process is covered by patents issued and pending.

The new process is applicable to both welded and seamless steel tubes and also to tubing made of brass, copper, bronze, aluminum, and Monel metal. Steel tubing as large as 4 inches outside diameter, with a wall thickness of 3/16 inch, has been shaped cold in the machine here illustrated, and the process could undoubtedly be applied to larger tubing by using a machine of greater capacity or by handling the work hot. Steel tubing can be reduced in size from 40 to 60 per cent of the original diameter. When steel tubing is to be shaped, the tubing must be annealed.

The principle involved in the Dewey Process consists simply of the use of two narrow rollers at the front and back of the revolving tubing, which are moved in and out radially relative to the tube axis as they are fed along the tube. The process is performed in a machine that resembles a long heavy-duty lathe, the work being held in chucks in a headstock and tailstock and the shaping rollers being mounted on a carriage that is fed along the bed and the work.

Potential Applications of the Dewey Process

The potential applications of tubing shaped by the Dewey Process are practically limitless from the standpoint of both utility and ornamentation. In manufacturing automobiles, for example, shaped

tubing can be used for such parts as propeller shafts, mufflers, exhaust pipes, manifolds, steering posts, horns, brake-rods, axle housings, and robe rails; in building airplanes, for struts, radiators, exhaust pipes, mufflers, radio masts, etc.; and in fabricating metal furniture, for chair and table legs, hat and coat stands, hospital equipment, and other parts. Airplane parts shaped from X4130 chromium-molybdenum steel have withstood severe tests.

Tubes can also be shaped for ornamental use in the manufacture of lamp stands, merchandising display stands, architectural details, musical instruments, and a large variety of other parts. The examples of shaped tubing shown in Fig. 1 indicate the practically endless variety of work that can be produced by the new process. Attractive finishes can be obtained on shaped tubing by chromium plating or Alumilite coloring.

Economy of material and simplified manufacturing methods are distinct advantages resulting from the use of shaped tubing in making many products. In addition, the Dewey Process enables tubing to be used for certain applications that were previously impractical commercially. For instance, long tapers that cannot be swaged can be readily formed by this process. Long tubes can be shaped with multiples of similar sections, after which the sections can be cut off for use as individual parts as, for example, venturi tubes or conveyor rollers of special designs.

A striking feature of this process is that the wall thickness of the shaped tubing can be increased, as indicated at *A*, Fig. 3, to obtain greater strength; decreased, as shown at *B*, to reduce the weight of the part; or left the original thickness, as shown at *C*. Owing to the fact that the tubing expands lengthwise as the rollers change the wall diameter, the tube shaping machine is made with a sliding headstock to allow for this expansion, the tailstock being anchored in a location that is determined by the length of tube being handled.

The headstock is connected to a long hydraulic cylinder that is capable of exerting a pressure of 12,000 pounds for retarding the movement of the headstock and thus increasing the wall thickness of the shaped portion of the tube. A pressure of 10,000 pounds can be applied for assisting the elongation of the tubing by moving the headstock in the same direction as the expanding tube, and thus reducing the wall thickness.

Referring to diagram *E*, Fig. 3, if D equals the original outside diameter of the tube, T the original wall thickness, and d the diameter at any given point, the maximum wall thickness t at d is approximately equal to $T \times \frac{D}{d}$, and the minimum wall thickness t is equal to $T \times \frac{d}{D}$. However, the minimum wall thickness should never be less than three-fourths of the original thickness.

In the case of a tube 4 inches outside diameter by 3/16 inch original wall thickness, the maximum wall thickness at a shaped diameter of 3 inches would equal $0.1875 \times \frac{4}{3}$ or 0.250 inch. The mini-

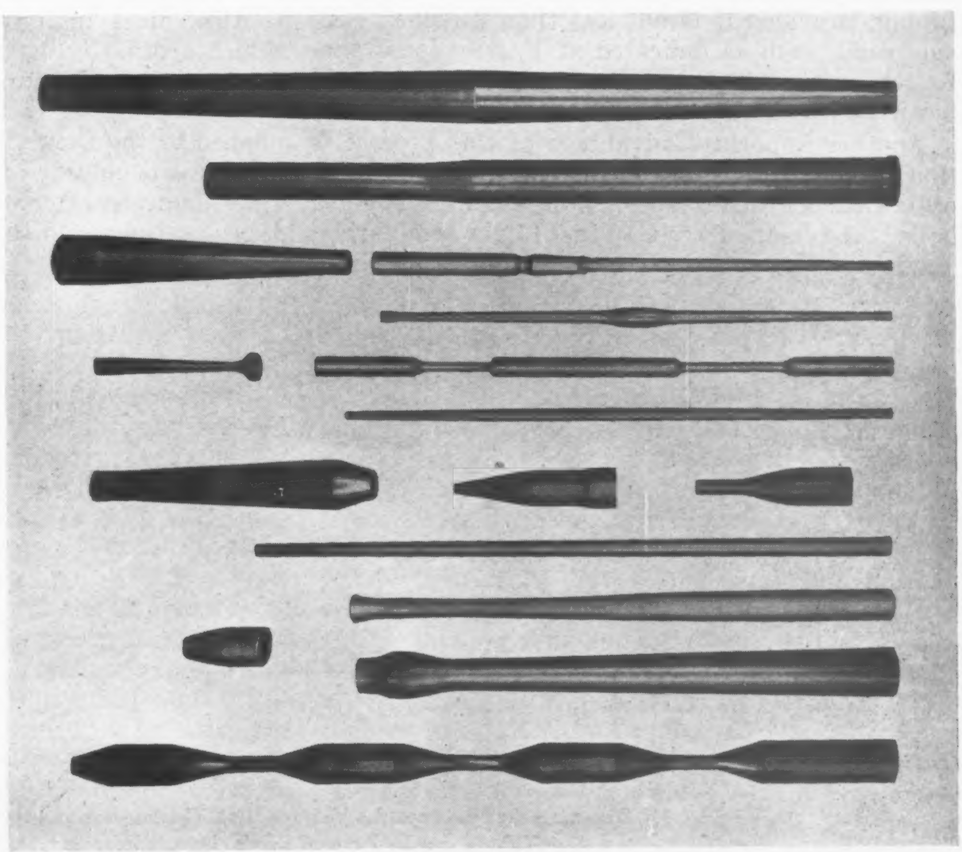


Fig. 1. Examples Indicating the Wide Range of Work that can be Produced by the Use of the Dewey Tube Shaping Process

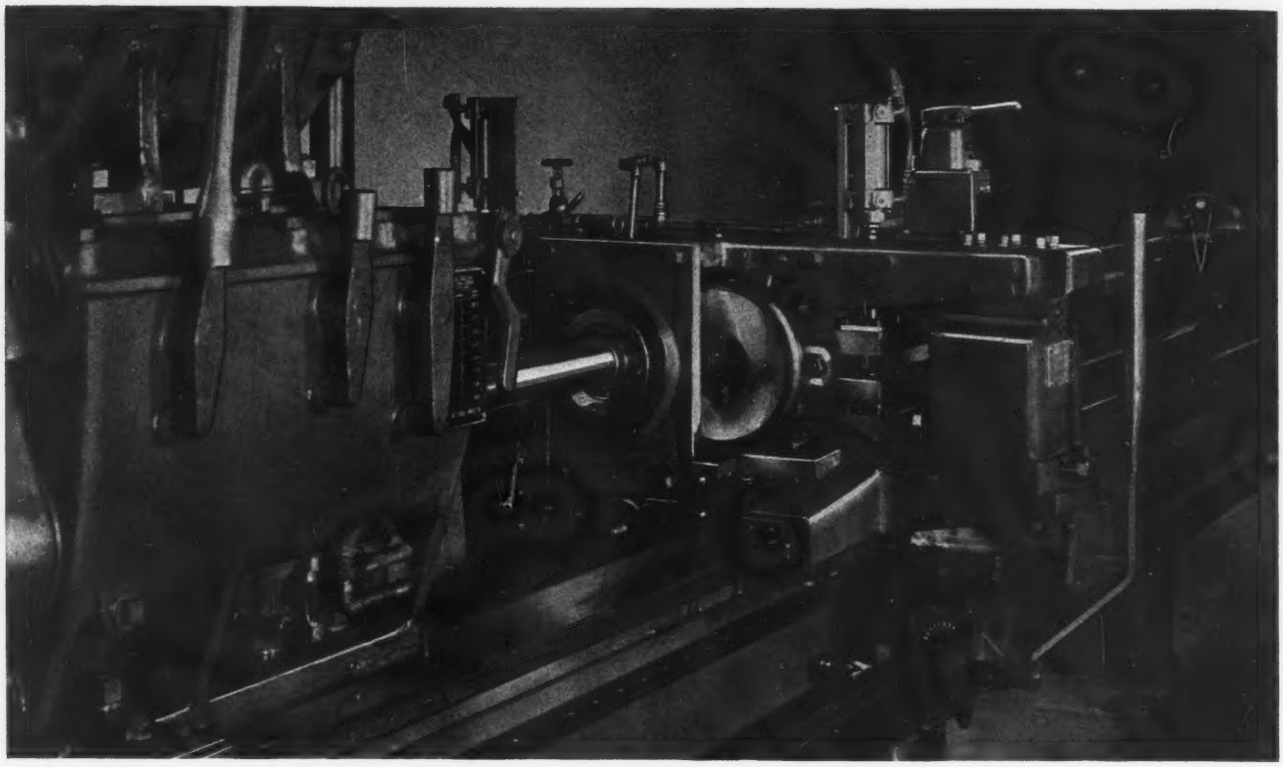


Fig. 2. Rollers Applied against the Front and Rear of the Tubing Form the Work to the Desired Contour as the Carriage Rides along the Bed

mum wall thickness at t would equal $0.1875 \times \frac{3}{4}$ or 0.140 inch. Outside fillets, such as indicated at X in diagram F, may be formed to a minimum radius equal to the original outside diameter of the tubing, provided it is not less than 2 inches. Inside radii, such as indicated at Y, may equal one-fourth of the original tube diameter, but should never be less than 1/2 inch.

Another important advantage of this process is that it greatly increases the strength and hardness of low-carbon steel tubes. For example, welded boiler tubes made from 0.10 to 0.15 per cent carbon steel, which have a tensile strength of 50,000 pounds per square inch as produced, will have a strength averaging 80,000 pounds per square inch in sections transformed to one-half the original diameter by this process.

Also, steel tubing of the analysis mentioned, which ordinarily has a hardness of from 55 to 60 Rockwell B in the annealed state, will have a hardness ranging up to 89 Rockwell B after being shaped by the Dewey Process. A 20-point jump in hardness is obtained with only slight reductions in tube diameter, after which the increase in hardness is proportionate to the reduction in diameter. All

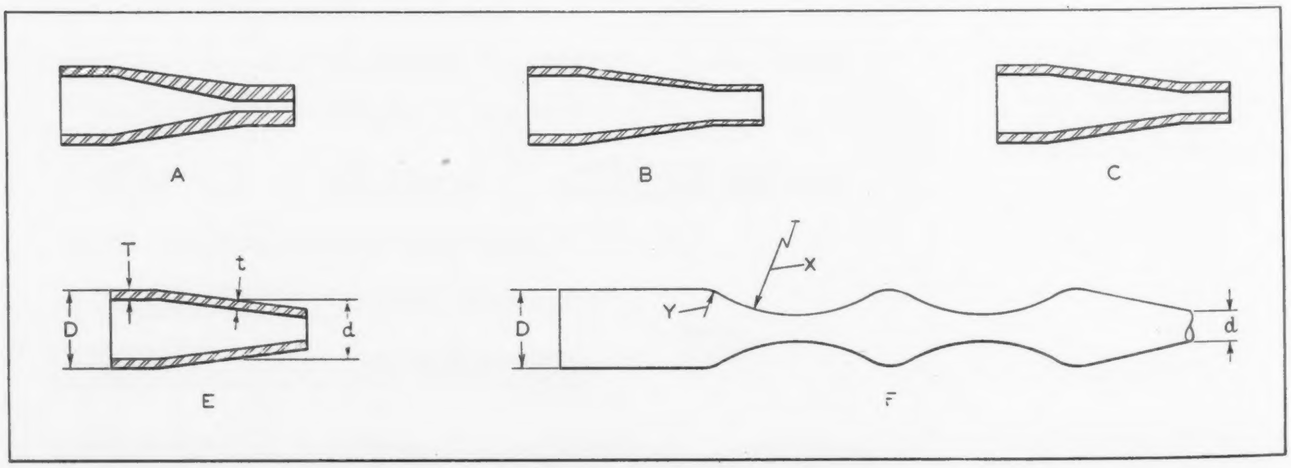


Fig. 3. Diagrams that Indicate the Various Wall Thicknesses and Radii to which Tubing can be Formed by the Dewey Process

Fig. 4. The Tailstock is Anchored in Predetermined Positions to Prevent Endwise Movement as the Tubing becomes Longer during Shaping by the Rollers

reductions on a tube surface must be accomplished in one operation in the machine, it being impossible to apply the shaping rollers a second time to the tubing.

General Description of the Dewey Tube Shaping Process

Tubes up to 20 feet in length can be shaped by the machine here illustrated. When the tubes being handled are smaller than 2 inches in diameter, they may extend an additional 10 feet through and beyond the tailstock. In this way, flagpoles or similar parts up to 30 feet in length can be handled, with not more than 20 feet operated upon by the shaping rollers. The large-diameter tubes are held in three-jaw chucks in both the headstock and the tailstock, while the smaller-diameter tubes are supported by air-operated collet chucks. The tailstock chuck is mounted on a full floating spindle that runs idly in anti-friction bearings, while the headstock chuck is operated at speeds of from 200 to 1160 R.P.M. Speed changes are accomplished through sliding gears, and power for driving the headstock spindle is delivered by a 50-H.P. motor.

Oilgear hydraulic equipment at both ends of the bed provide pressure in long cylinders for actuating the carriage and headstock. The carriage cylinder applies a pressure of 30,000 pounds, and has a stroke of 21 feet, while the headstock cylinder has a stroke of 7 feet. The carriage feeds range from 0 to 12 feet per minute, and there is a rapid traverse of 70 feet per minute for returning the carriage to the tailstock at the end of an operation, and a rapid traverse of 35 feet per minute for moving the carriage forward to the point where the shaping of the tube is to commence, or to pass over an unworked section.

The hydraulic valves that control the carriage movements are actuated through a bar that extends along the front of the machine. Automatic operation of this bar is obtained through the use of cams that contact with a roller on the lower end of the lever seen at the front of the carriage. Manual operation of the hydraulic valves can also be effected through this lever. The headstock can be operated at variable feeds to assist or retard the endwise expansion of the tubes as they are being formed. The headstock can also be operated at a rapid traverse rate of 30 feet per minute for positioning it prior to an operation.

Movement of the tailstock during an operation is prevented by anchoring it to bars at the front and rear of the bed. Pins are used to lock the tailstock base to these bars. When the position of the tailstock, which is rather heavy, must be changed between operations, the tailstock is moved along the bed by connecting it through tie-rods to the carriage and applying the hydraulic mechanism.

The forming or shaping rollers are applied at both the front and rear of the tube, as mentioned, a portion of both rollers being visible in Fig. 2 and the rear roller in the heading illustration. These rollers are 13 1/2 inches in diameter, and are constructed of hardened tool steel, with the periphery rounded for easily displacing the tube material be-

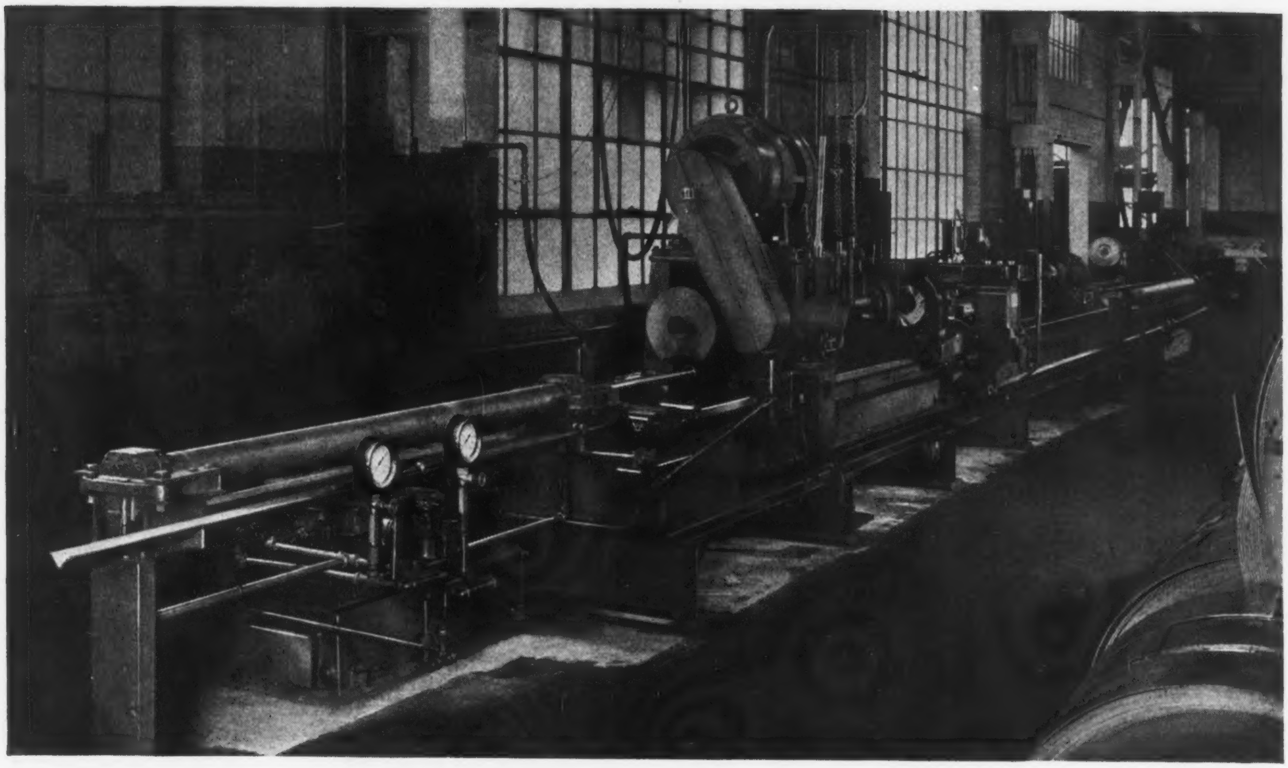


Fig. 5. General View of the Machine Used in Shaping Tubes by the Dewey Process, Hydraulic Equipment being Provided at Both Ends of the Bed for Feeding and Traversing the Headstock and Roller Carriage

ing shaped. Soluble oil is applied to the rollers and work to facilitate the shaping operation and cool the tube.

The tube is supported in a free-turning bushing just ahead of the two rollers, which run idly in contact with the work. The bushing reinforces the tube at a point immediately adjacent to the area being shaped. The rollers are mounted in sliding blocks, which are actuated from a cam attached to a support that extends along the rear of the bed. A vertical pin on the sliding block that carries the rear roller rides along this cam to feed the block forward in accordance with the profile of the cam. Spring action tends to hold the pin in contact with the cam. All movements imparted to the rear roller slide are also transmitted to the front roller slide through gearing on the under side of the carriage.

In cases where heavy shaping of tubes is performed, a cam can be provided at the front of the bed, which acts directly on a pin on the front roller slide, in addition to the cam for the rear roller slide. The pins on both roller slides that contact with these cams are raised and lowered by air. Horizontal rollers are provided at the front and back of the carriage to support the outer side of the cam bars and thus prevent any "give" of the bars. Through this provision, the cam bars are held accurately parallel with the headstock and tailstock spindles at all times.

The tube shaping rollers can be applied on the tubing diametrically opposite each other, as in the case of light shaping operations, or they can be offset so that one tool is applied in advance of the other. The latter method is used in heavy shaping operations. The rollers can be adjusted both axially and in and out with respect to the work. Each roller arbor is mounted in two S K F spherical roller bearings and provided with a ball thrust bearing.

Close Tolerances Can be Maintained

Specified dimensions can be obtained by this process within plus or minus 0.010 inch with respect both to tube diameter and wall thickness. Closer tolerances necessitate uniformity of tubing temper and uniformity of the original tube diameter.

* * *

Machinery Exports Reach a New High Level

The exports of machinery from the United States during the month of October, 1940, amounted to $43,567,000, the highest value ever reached in a single month. The previous high level was reached in December, 1920, when the exports amounted to about $41,600,000.

The shipments of power-driven metal-working machinery showed the largest increase, rising to the record value of $26,799,000. Machine tool exports to England amounted to $19,902,600, as compared with $15,070,000 in September. Shipments to Russia decreased to $130,600, compared with $895,000 the previous month.

Manufacturers' Association Adopts Program for the Future of America

THE forty-fifth annual meeting of the National Association of Manufacturers was held at the Waldorf-Astoria Hotel, New York City, December 11 to 13. The general theme of the meeting was "Total Preparedness for America's Future." Many addresses and papers were presented under the following five subdivisions: Need for Total Preparedness; Production Aspects of Preparedness; Economic Aspects of Preparedness; Intellectual and Spiritual Defenses; and Post-War Readjustments. Some of the most prominent and best known industrialists in America were among the speakers, as were also men from many other fields of endeavor, representatives of the Government, journalists, educators, and economists.

A platform for "The Future of America" was adopted, some excerpts from which are given in the following:

"We recognize the vital part that American industry must play in securing the strength and welfare of the nation. Industry, in the broadest sense, is America at work. It is the production of goods and services by millions of men and women working on farms, in mines, in factories, in offices, in shops. It is the American people themselves who make industry. They provide the capital, they furnish the labor, they consume the output. All have a vital stake in the process.

"Well supported churches, well equipped schools, comfortable homes, busy stores and offices, all depend upon busy farms, mines, and factories. The people, in order to maintain their standard of living, want the goods and services that industry can produce. But today they are demanding, in addition, the goods and services with which to build defenses so strong that the nation will be safe against foreign aggression.

"It is upon industry that the people must depend if the goods and services for both of these purposes are to be produced. It is to the free enterprise system that the people must look if the nation's defenses are to be provided in a manner which will preserve, and not destroy, the way of life they are designed to defend.

"Healthy industry is as essential to the production of adequate military equipment and to the maintenance of the American standard of living as are healthy men to an efficient army and navy. America has been built to its present stature by the free enterprise and individual initiative of its people.

"Here in America we have an abundance of natural resources, of man power, of machines, of capital, of organizing and technical skill. Inventors' workshops and research laboratories are constantly supplying new things that create new jobs and contribute to a higher standard of living as they are developed into commercial products. The main assurance of the future welfare of America lies in the present and potential wants of the people and in the ability of free enterprise to provide the goods and services the people desire.

"Today, and for the future, the American people want strength and security, built upon the freedom of individual opportunity. It is this freedom of opportunity that has served America so well in the past; that can make the nation strong and secure in the existing crisis; that can bring security to the individual in the years ahead, in such measure as his individual effort can achieve."

Standardization of Screw-Thread Gages and Gaging

The American Society of Mechanical Engineers, 29 W. 39th St., New York City, in its capacity as administrative sponsor for the Sectional Committee on the Standardization and Unification of Screw Threads, has announced the completion of a tentative draft of a proposed "American Standard for Screw-Thread Gages and Gaging." The purpose of this proposed American Standard is to make available to industry the generally approved tolerances for screw-thread gages in the various classes of fits, and the generally accepted gaging practice in the use of these gages for inspection. Ralph E. Flanders, president of the Jones & Lamson Machine Co., is chairman of the committee that has prepared the proposed standard. A limited number of copies of the proposed standard are now available to those who are especially interested in the gaging of screw threads, by addressing the American Society of Mechanical Engineers.

* * *

Since everything in this civilization worth having is produced by work, it is obvious that when a nation begins to shirk work, it is doomed to take second place among the nations of the world. Those who favor a thirty-hour week are actually advocating a lower standard of living.

Supervising Operations in Plants Working Two or Three Shifts

SOME of the principles involved in the supervision of plants operating two or three shifts were referred to in a paper read before the Cleveland Production Conference of the American Management Association by Henry V. Oberg, company industrial engineer of the Armstrong Cork Co., Lancaster, Pa. The principles outlined are based upon extended experience in plant operation involving two or three shifts. It has been found most satisfactory, said the speaker, to place the complete responsibility for the operation of a department on one foreman, irrespective of the number of shifts. This foreman has under him shift foremen or supervisors to cover the shift or shifts when the foreman-in-charge is not on duty.

The foreman-in-charge is responsible for the general operation of the department—costs, personnel problems, scheduling, quality of work, etc. He has charge of the daytime shift, endeavors to cover the administrative problems of the department, including requisitioning of materials, personnel problems, and scheduling of work during the hours he is on duty.

The shift foremen or supervisors are expected only to keep the department running efficiently as far as quantity and quality of product are concerned. Other operating duties should not be placed on these men, except in cases where there is an unforeseen shortage of material, a breakdown, an accident, or sickness. The shift foreman makes a written record of the problems encountered, and includes any instructions necessary for the subsequent shift foreman. This record also keeps the foreman-in-charge posted on what has happened during the shift when he was not on duty. Verbal instructions should be avoided as far as possible, because they frequently lead to misunderstanding and are subject to misinterpretation.

Another important problem of three-shift operation is the scheduling or shifting of the workers. Three 8-hour shifts have been found most satisfactory when 24-hour operation is necessary. With five working days, this will mean a 37 1/2- or a 40-hour week for each man, depending upon whether the plant is shut down for a lunch period or operates continuously. At the end of every week the men "swing" to a different shift. Sometimes the "swing" period may be two weeks instead of one. If a man works from 7 A.M. to 3 P.M. one week, he works from 3 P.M. to 11 P.M. the next week, and from 11 P.M. to 7 A.M. the third week. In this way, all men are treated alike and there is no favoritism as regards working hours. Also, this system makes it unnecessary to pay a premium for the night shift, since all employes work on the night shift in turn.

The shift foremen swing from the different shifts, the same as the men. The best results are obtained when the shift foremen supervise the same men, in so far as this is possible. When the shift foreman works with his own men week after week, he is usually able to obtain better results than if he supervised a different group each week.

The complete report of the Production Conference is available through the American Management Association, 330 W. 42nd St., New York City.

Building Up Worn Parts by Spraying with Stainless Steel

THE spraying of worn parts with stainless steel by a metallizing process and then remachining to size, as applied by a middle western railroad, has produced reconditioned parts giving from 100 to 300 per cent of their original life. Many locomotive parts that would normally be scrapped are reclaimed and reconditioned by this process, as well as such parts as water-pump piston-rods, motor armature shafts, etc. For metallizing, 18-8 stainless steel in wire form is used. Prior to spraying, all surfaces are sand-blasted, which not only thoroughly cleans the surface, but also roughens it so that the sprayed metal will easily adhere to it. The thickness of the layer sprayed on the surface is usually from 1/64 to 1/32 inch in excess of the size to which the part is to be machined.

To obtain the finish required, it has been found desirable to turn the sprayed metal at high speeds, from 200 to 450 feet per minute, with fine cuts and a slow feed, Carboloy tools being used for turning. Parts that cannot be conveniently turned are finished by grinding.

As an example of a typical part being reclaimed in this manner may be mentioned a pump rod. In remachining, a cutting speed of 242 feet per minute, a depth of cut of 1/64 inch, and a feed of 0.005 inch is being used. The length of the rod is 2 feet and its diameter 1 3/4 inches. The floor-to-floor time for finishing the shaft is twenty minutes, approximately twelve pieces being machined per tool grind. Obviously, the savings due to this method of reclaiming are quite marked.

Machine Tool Expansion for National Defense

PRACTICALLY the entire output of the nation's vastly expanded machine tool industry is destined for the National Defense Program of the United States and the defense of England, with by far the major share going to aircraft builders and other manufacturers of national defense requirements in the United States. These facts are brought out by a survey just completed by the National Machine Tool Builders' Association, Cleveland, Ohio. The survey is based upon information as to plant expansion, employment, and development work undertaken on behalf of the National Defense Program, and was obtained from 115 companies representing 80 per cent of the machine tool building capacity of the country.

Increased output has been accomplished by plant expansion, by the installation of new equipment, by sub-contracting work to outside companies, and by training large numbers of new men to operate plants on two and three shifts. Employment in industry has more than doubled in the last two years, the bulk of the increase having taken place during the present year. Almost one-half of the employes in the machine tool shops today have been trained for their jobs since September, 1939.

A chart accompanying the survey shows that machine tool production, which in the peak year of 1929 totalled $185,000,000, averaged less than $25,000,000 in 1932 and 1933. A slow recovery from the depression brought the volume to $85,000,000 in 1935. The chart indicates that defense production will reach $400,000,000 in 1940. The anticipated output for 1941 will be at the rate of $600,000,000. A copy of the survey can be obtained from the National Machine Tool Builders' Association, 10525 Carnegie Ave., Cleveland, Ohio.

Pratt & Whitney Aircraft Aids Operation of Defense Training Center

THE Pratt & Whitney Aircraft Division of United Aircraft Corporation, East Hartford, Conn., is cooperating with the Re-Employment Commission of the state of Connecticut in an endeavor to conduct an extensive job training program which will provide a large proportion of the 3000 workers needed by this company within the next three months. As a result of this cooperation, there has been organized a completely equipped school known as the "Hartford State Trade School, Defense Training Center," which occupies about 30,000 square feet in a Hartford machine plant.

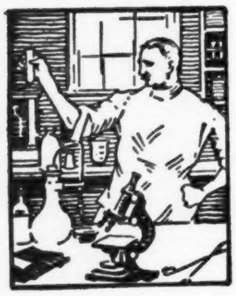
This school is equipped with approximately fifty machine tools, including milling machines, lathes, drilling machines, grinders, and gear shapers of various types. These machines have been provided by the Pratt & Whitney Aircraft Division, as well as materials, jigs, fixtures, and shop instructors. The state of Connecticut has supplied classroom instructors, clerical staff, light, and electric power. The facilities have recently been expanded, so that approximately 350 men are being trained, and provision is being made to increase the enrollment to 1500. Already, over 400 men have graduated and taken their places in the aircraft engine plant.

To be eligible for training in the school, the applicant must be an American citizen, over eighteen years old, must have a high-school education or its equivalent, and must be physically fit. No previous experience with machine tools is necessary. The applicant receives an adaptability test and a preliminary examination by the State Employment Commission, and also appears before a Pratt & Whitney Aircraft employment manager. Every effort has been made to minimize delay, so that applicants are received and accepted daily.

About 320 hours of training are provided for each student, of which about 180 hours are taken up by instruction given in the shop and classrooms. Each student works on an eight-hour shift, six days a week, and receives a regular wage while in school. At present there are three shifts of students.

Each student is taught how to operate one particular type of machine tool, so that he may become a specialist in some operation of fabricating or machining actual airplane engine parts. His training also familiarizes him with the speeds and feeds, and with jigs and fixtures of the types used in the shop. Skilled shop men from the production departments at Pratt & Whitney Aircraft impart their specific, practical knowledge to the trainees. Correlated studies include mathematics, blueprint reading, and a review of accessories and materials. The use of precision measuring instruments, including inspection gages, is also taught. Immediately upon graduation, the student is put on production work at the East Hartford plant.

MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

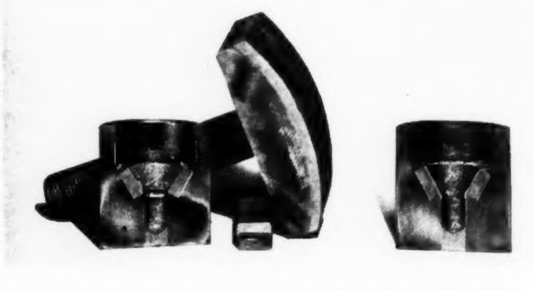
Three Hard-Surfacing Alloys Recently Developed

Three new hard-surfacing alloys — Colmonoy Nos. 4, 5, and 6—have recently been added to the line of alloys produced by the Wall-Colmonoy Corporation, Detroit, Mich. Colmonoy No. 4 is suitable for application to metal-forming and drawing dies, as well as parts that are subjected to a certain amount of abrasion. It can also be applied to cast iron. It has a hardness of 35 to 40 Rockwell C and can be machined without great difficulty, which is of importance in die work.

Colmonoy No. 5 has a Rockwell C hardness of approximately 45 to 50, and is well suited for such applications as high-temperature steam valve trim, solid shaft bearing surfaces, and other uses where moderate machinability combined with good wear resistance and freedom from galling is required.

Colmonoy No. 6 has a Rockwell C hardness of approximately 55 to 60, and has the greatest abrasion resistance of the four Colmonoy nickel-base alloys. This material is used extensively on parts subjected to great abrasion and on parts permitting very small wear tolerances. It has high compression strength and can be used in applications where heavy pressures are encountered. However, for such use, the metal behind the Colmonoy must have sufficient strength to hold up, since deformation of the steel behind the alloy will allow the alloy overlay to crack.

Another interesting new development is the Colmonoy furnace weld process, which consists in casting the Colmonoy No. 6 overlay by regular foundry methods and then applying this casting to a steel part in a controlled-atmosphere furnace. In this process, one of the low melting components of Colmonoy No. 6 is used as the bonding agent. This method is suitable for high-production work and for applications where it is not possible to make a weld due to the intricacies or inaccessibility of the part. 201



Examples of the Use of the Hard-surfacing Alloy Colmonoy No. 6 Applied by a New Furnace Weld Process

S A E 4815 Steel Used for Heavy-Duty Gear and Shafting Applications

The carburizing nickel-molybdenum S A E 4815 steel has recently become quite widely used for heavy-duty gear and shafting applications. In the normalized condition, its machining properties compare with S A E 4615 and S A E 2315 steels as regards cutting speeds and finish. The carburizing practice is much the same as that used for S A E 2315. Although some shops quench direct, a single quench from above the core critical temperature, after slow cooling from the carburizing temperature, is preferred. As regards distortion, the steel acts similarly to S A E 2315 and S A E 4615 steels.

An outstanding advantage of the S A E 4815 steel is the high core strength that can be developed by a single quench. In sections up to 1 inch in diameter, tensile values up to 200,000 pounds per square inch and yield strengths in the neighborhood of 165,000 pounds per square inch can be developed in the core, together with hardness up to 415 Brinell. The tough, fine-grained case has excellent resistance to wear, spalling, and pitting fatigue.

The steel is recommended for heavy-duty parts such as gears, pinions, spindles, splined transmission shafts, airplane motor parts, pneumatic tools, tractor parts, oil-field power transmissions, and similar applications. According to Joseph T. Ryerson & Son, Inc., Chicago, Ill., this material is available in hot-rolled bars, not annealed, having diameters ranging from 1/2 inch to 6 inches. 202

To obtain additional information about materials described on this page, see lower part of page 212

Metal Plating Suitable for Application to Plastics

Enameling and lacquering were formerly the only finishes applicable to plastics. A process recently developed by the Metaplast Corporation, New York City, now provides for the depositing of metal on the surface of plastics of all types. This can be done without impairing any of the physical properties of the plastics, except that of electrical insulation, the metal coating acting as a conductor....203

New Tool Steel Having Unusual Toughness

A medium-carbon manganese-molybdenum steel known as 773 tool steel has recently been added to the line of the Jessop Steel Co., Washington, Pa. This tool steel possesses a high degree of toughness, which makes it suitable for use in dies, punches, cutting tools, chisels, etc., and for a variety of applications where exceptional toughness in thin sections, as in step-down dies, putty knives, etc., is required. A 1/4-inch section in the hardened and drawn condition (Rockwell C 58) will take a permanent set without cracking or bending.

The toughness of this tool steel is illustrated by tests on a chisel made from it, conducted in an outside plant. The superintendent of this plant drove the chisel, corner first, into an anvil; used it for cutting unannealed steel; then supported it at both ends and repeatedly hammered the unsupported mid-section. In no case was he able to break the chisel, nor did it show any deformation, as can be seen from the unretouched photograph of the chisel, which was taken after the tests had been made..204

Chisel Made of Jessop 773 Tool Steel Shows No Deformation after Severe Tests

Nickel Bronzes Developed for Special Applications

Superior bronzes containing from 5 to 15 per cent nickel have been developed for special applications at reasonable cost. Some of these alloys in the "as cast" condition have a strength of from 45,000 to 48,000 pounds per square inch, which, by heat-treatment, can be brought up to from 75,000 to 80,000 pounds per square inch. Bronzes of this type are not subject to changes in structure or composition by outdoor exposure. They have been found useful for highly stressed members of transmission-line switch gears and conductor wire supports. The high strength and dense structure of these alloys provide long life for wearing parts. In many fields, nickel is being increasingly used in producing pressure-tight brass and bronze castings.......205

Castolin Eutectic Alloys for Low-Temperature Welding

A series of eutectic alloys for the welding of metals at temperatures below their melting point, known by the trade name "Castolin," are being manufactured by the Eutectic Welding Alloys, Inc., 40 Worth St., New York City. These alloys were formerly imported into this country. They are applicable to the joining of a wide range of metals, and have been successfully used for low-temperature color-matching welds on cast iron; the welding of intricate and delicate castings; and low-temperature brazing of steel, malleable cast iron, tungsten carbide, aluminum, and the joining of copper and non-ferrous metals to aluminum.

The advantages claimed for the use of these eutectic alloy welding rods are rapidity of operation, freedom from warpage due to high temperatures, and protection against detrimental structural changes in the base metal.

In operation, the eutectic alloy rod melts and fuses with the base metal, which is heated but not molten. The bond is accomplished by a capillary action, which causes the penetration and diffusion of the molten eutectic alloy in the solid base metal. The resulting joints have been shown by tests conducted over a period of years to be strong, reliable, and not subject to electrolytic disintegration...............................206

New Metal Coatings for Rust Prevention

A series of rust preventives, including liquid rust-inhibiting, non-drying products made from a newly developed base, is announced by E. F. Houghton & Co., Philadelphia, Pa. This series also includes grease type (non-drying) products; drying, hard-film products; semi-drying (waxy film) and soluble rust preventives. The new basic material provides a homogeneous non-crystalline film with a high degree of cohesion and adhesion to metals. It wets the surface rapidly, making an unbroken film, impervious to atmospheric conditions. A new method of rust prevention testing has also been developed to aid in selecting the most adequate anti-corrosive covering. 207

To obtain additional information about materials described on this page, see lower part of page 212

NEW TRADE  LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Check on Form at Bottom of Page 211 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the January Number of MACHINERY

Turret Lathes

JONES & LAMSON MACHINE CO., Springfield, Vt. Publication entitled "Turret Lathe Earning Power," presenting in a striking manner the answers to twelve fundamental questions that will enable the purchaser to determine the earning power of any turret lathe equipment; illustrated with large-scale halftones. 1

Contour Metal Shaping Machines

CONTINENTAL MACHINES, INC., 1301 Washington Ave. S., Minneapolis, Minn. Catalogue entitled "DoAll Makes Vital Armament Parts in Record Time," describing, in detail, the DoAll contour metal shaping machines, available in sizes and capacities to meet the demands of all industries. 2

Gas Shape-Cutting Machines

AIR REDUCTION, 60 E. 42nd St., New York City. Bulletin on Airco No. 10 Planograph, a shape-cutting machine of the pantograph type for single- or double-torch operation. Also, bulletin on Oxygraph and Travograph gas-cutting machines for cutting shapes from steel plates, slabs, billets, and forgings. 3

Nickel Alloys—Tubing and Gears

INTERNATIONAL NICKEL CO., INC., 67 Wall St., New York City. Bulletin T-17, containing technical information on the fabrication of Monel, nickel, and Inconel seamless pipe and tubing. Bulletin entitled "Modern Trends in Nickel-Steel and Cast-Iron Gear Materials." 4

Slide-Rule for Welding and Sheet-Metal Industry

INTERSTATE SALES CO., 1123 Broadway, New York City. Circular descriptive of a device known as the Wolfe Angle Meter, by means of which any angle up to 90 degrees can be laid out directly on pipe or flat material without making calculations. 5

Optical Strain Gages

AMERICAN INSTRUMENT CO., 8010 Georgia Ave., Silver Spring, Md. Bulletin 2084, describing the Tuckerman optical strain gage for measuring tension and compression strains as small as 0.000002 inch in various materials and structures. 6

Graphitic Steels

TIMKEN ROLLER BEARING CO., Steel and Tube Division, Canton, Ohio. Catalogue containing a series of questions and answers relating to graphitic steels, their properties and heat-treatment. Twenty-four case histories of tools and dies made from these steels are included. 7

Presses and Shears

NIAGARA MACHINE & TOOL WORKS, 637-697 Northland Ave., Buffalo, N. Y. Vest-pocket booklet 106-A, containing a condensed presentation of the complete line of Niagara presses, shears, and machines for all classes of plate and sheet metal work. 8

Welding Equipment

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Booklet 26-100, containing data on Flexarc motor- and engine-driven welding machines. Bulletin 26-320, describing the new Midget Marvel Flexarc alternating-current welder. 9

Hydraulic Presses

PACIFIC HYDRAULIC PRESS & TOOL CO., P.O. Box 87, Huntington Park Station, Los Angeles, Calif. Circular describing hand-operated hydraulic presses, designed to fill the need for a utility tool in machine shops and manufacturing establishments. 10

Instructions for Using Carboloy Tools

CARBOLOY COMPANY, INC., 11147 E. 8 Mile Road, Detroit, Mich. Instruction manual, 3 by 4 1/4 inches, containing all the information essential to the use and care of standard Carboloy tools. 11

Nibbling Machines

ANDREW C. CAMPBELL DIVISION, AMERICAN CHAIN & CABLE CO., INC., Bridgeport, Conn. Catalogue entitled "Why Not Nibble It?" announcing a new wide-range nibbling machine that will handle stock up to 72 inches wide. 12

Gas Furnaces

AMERICAN GAS FURNACE CO., Elizabeth, N. J. Condensed Catalogue and Data Book 602, covering this company's complete line of gas furnaces, burners, etc. Includes charts showing heat-treatment for various S A E steels. 13

Gear Cutting and Finishing Machines

MICHIGAN TOOL CO., 7171 E. McNichols Road, Detroit, Mich. Bulletins covering the latest models of Michigan gear-cutting, gear-lapping, gear-checking, and hob-checking equipment. 14

Ball and Roller Bearings

LINK-BELT CO., 307 N. Michigan Ave., Chicago, Ill. Book No. 1775, entitled "Link-Belt Friction Fighter Bearings," an 88-page data book for all who use, recommend, or buy bearings and power-transmission equipment. 15

Cleaning Handbook

MAGNUS CHEMICAL CO., INC., Garwood, N. J. Aviation Cleaning Handbook, describing cleaning methods and materials for use in the maintenance of aircraft, airports, engine shops, etc. 16

Clutches

CONWAY CLUTCH CO., 1543 Queen City Ave., Cincinnati, Ohio. Bulletin L-29, describing stud-drive disk clutches in horsepower capacities

ranging from 13 to 200 H.P. at 100 R.P.M. 17

Balancing Machines

GISHOLT MACHINE CO., 1209 E. Washington Ave., Madison, Wis. Performance Data Sheet No. 65, describing an example of static-dynamic balancing performed on a Gisholt Dynetric balancing machine. 18

Electric Equipment

GENERAL ELECTRIC CO., Schenectady, N. Y. Bulletin 1542D and 1868B, on heavy-duty direct-current motors; 2964B, on magnetic motor starters; and 3307, on self-starting synchronous inductor motors. 19

Photo-Electric Control

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Circular 18-312, describing the Type RQ "Photo-Troller," a new photo-electric relay for industrial, commercial, and home application. 20

Hydraulically Operated Barrel Pumps

TRABON ENGINEERING CORPORATION, Cleveland, Ohio. Circular illustrating and describing Trabon hydraulically operated barrel pumps for industrial use. 21

Welding Stainless-Clad Steel

INGERSOLL STEEL & DISC DIVISION OF BORG-WARNER CORPORATION, 310 S. Michigan Ave., Chicago, Ill. Manual of welding and fabricating procedures for Ingaclad stainless-clad steel. 22

Surface Grinders

HILL ACME CO., 6400 Breakwater Ave., N.W., Cleveland, Ohio. Bulletin H-V-2, covering heavy-duty, precision hydraulic surface grinders, of both horizontal and vertical spindle types. 23

Steel

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York City. Data and stock list of alloy and machinery steels; also 32-page booklet entitled "Tool Steel for the Non-Metallurgist." 24

Precision Lathes

SOUTH BEND LATHE WORKS, 719 E. Madison St., South Bend, Ind. Catalogue 16-T, on the new South Bend 16-inch, Series S, precision lathe and attachments. 25

Metal-Cutting Saws

PEERLESS MACHINE CO., 1600 Junction Ave., Racine, Wis. Bulletin 52, covering the Peerless line of metal-cutting saws, including standard, as well as hydraulic types. 26

Hydraulic Presses

BALDWIN SOUTHWARK DIVISION OF THE BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa. Bulletin 160, illustrating and describing the Southwark line of self-contained hydraulic presses. 27

Paraform Milling Cutters

BARBER-COLMAN CO., 203 Loomis St., Rockford, Ill. Bulletin describing "Paraform" milling cutters, and giving production data on various jobs. 28

Tool-Room Chart

MCKENNA METALS CO., 147 Lloyd Ave., Latrobe, Pa. Chart on which is printed an inch rule and a protractor for measuring tool dimensions and angles. 29

Automatic Lubrication

ACE LUBRICATING EQUIPMENT CO., INC., 2345 W. Grand Blvd., Detroit, Mich. Bulletin entitled "Know Your Lubrication at a Glance," illustrating and describing Ace automatic lubrication equipment. 30

Flexible Shafts and Machines

N. A. STRAND & CO., 5001 N. Wolcott Ave., Chicago, Ill. Catalogue 28, containing 80 pages on the Strand line of flexible shafts and machines for a wide variety of operations. 31

Hydraulic Straightening Presses

DENISON ENGINEERING CO., Chestnut and Water Sts., Columbus, Ohio. Bulletin 106, describing a newly de-

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MACHINERY, 148 Lafayette St., New York, N. Y.

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27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	50-A	

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signed hydraulic straightening press in 25- and 50-ton capacities. 32

Metal-Cleaning Methods

OAKITE PRODUCTS, INC., 26 Thames St., New York City. Booklet entitled "Cleaning of Metals Before Electro-Plating," giving an outline of Oakite materials and methods. 33

Screws, Bolts, Nuts, and Rivets

CENTRAL SCREW CO., 3501 Shields Ave., Chicago, Ill. Catalogue K, on screws, bolts, nuts, and rivets, with complete tables of dimensions and available sizes. 34

Roller Bearings for Aircraft

SHAFER BEARING CORPORATION, 35 E. Wacker Drive, Chicago, Ill. Bulletin 531, containing essential data on Shafer aircraft type self-aligning roller bearings. 35

Adjustable-Limit Snap Gages

JAS. CLARK, JR., PNEUMATIC TOOL CO., 143 Seventeenth Ave., Paterson, N. J. Circular listing the capacities and prices of Clark adjustable-limit snap gages. 36

Rotoblast Cleaning Equipment

PANGBORN CORPORATION, Hagerstown, Md. Bulletin 213, on Rotoblast rocker barrels for cleaning castings and other metal parts. 37

Steel-Backed Babbitt Bearings

MORAINE PRODUCTS DIVISION GENERAL MOTORS CORPORATION, Dayton, Ohio. Circular entitled "Powdered Metal Compact Bonds Babbitt to Steel Back." 38

Electric Furnaces

NORTON CO., Worcester, Mass. Booklet prepared as an aid in the design and construction of small electric furnaces suitable for laboratory use. 39

Vertical Profiler

MOREY MACHINERY CO., INC., 410 Broome St., New York. Circular 680, describing a motor-driven vertical profiler and milling machine. 40

Pumps

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis. Bulletin B6140, on "Electrifugal" pumps—1 to 10 H.P. —for heads up to 160 feet. 41

Automatic Lubricators

TRICO FUSE MFG. CO., 2950 N. 5th St., Milwaukee, Wis. Bulletin 28, on Trico unbreakable thermal oilers for visible, automatic lubrication. 42

Steel Plates

LUKENS STEEL CO., Coatesville, Pa. Bulletin on Lukens steel plates, giving technical data for the engineer and buyer of steel plates. 43

Machinists' Tools

GEORGE SCHERR CO., INC., 128 Lafayette St., New York City. Circular on machinists' tools, including various combination sets. 44

Portable Electric Tools

SKILSAW, INC., 5033 Elston Ave., Chicago, Ill. Catalogue 42, covering the complete line of Skilsaw portable electric tools. 45

Lock-Nuts

FABRISTEEL PRODUCTS, INC., 642 Beaubien St., Detroit, Mich. Circular containing data on a new type of lock-nut known as "Fast-On." 46

Files

CLEVELAND FILE CO., Cleveland, Ohio. Catalogue and data book of useful information for the man who uses or buys files. 47

Toggle-Action Clamping Tools

KNU-VISE INC., 16841 Hamilton Ave., Detroit, Mich. Catalogue 4, on toggle-action clamping tools. 48

Motor Control Equipment

CUTLER-HAMMER, INC., Milwaukee, Wis. Publication CS-151, on "Unitrol," a new development in motor control engineering. 49

Lighting Equipment

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Manual entitled "How to Design Fluorescent Lighting. 50

Carburizing Baths

A. F. HOLDEN CO., New Haven, Conn. Bulletin on Holden carburizing baths. 50-A

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 213-226 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment mark with X in the squares below, the identifying number found at the end of each description on pages 213-226—or write directly to the manufacturer, mentioning machine as described in January MACHINERY.

51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69
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Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Barber-Colman Improved Hobbing Machine

The new Type T hobbing machine built by the Barber-Colman Co., 203 Loomis St., Rockford, Ill., incorporates many improvements, and is available with several new attachments. Although this machine was originally designed primarily for hobbing taper splines on shafts, it has a wide application for hobbing spur gears, spiral gears, straight splines, worms and worm-wheels, and miscellaneous hobbed forms.

In many respects, this machine resembles the Barber-Colman Type A hobbing machine used on general-purpose or high-production work. The main difference is in the hob swivel construction which, on the Type T machine, provides a means for traversing the hob longitudinally and laterally at the same time, so that the hob may be fed in at an oblique angle to the work, which is necessary in hobbing taper splines on the end of a shaft. In hobbing spur gears, straight splines, spiral gears, etc., this oblique hobbing method can be used or the hob spindle can be turned around so that the ways are parallel with the bed ways, and the work can be hobbed in the conventional manner. Hobs up to 4 inches in diameter by 4 inches long can be accommodated.

The operating and controlling mechanisms are somewhat different from those on the ordinary hobbing machine. There is an additional feed-screw in the lower hob swivel-slide to give the hob its longitudinal traverse. A micrometer dial is provided on the work-slide which permits the operator to read at a glance the exact height of the center line of the work-spindle above the center line of the hob-spindle. A similar dial on the main feed-screw covering the whole length of the longitudinal adjustment shows the exact distance between the spindle nose and the center line of the hob carriage unit.

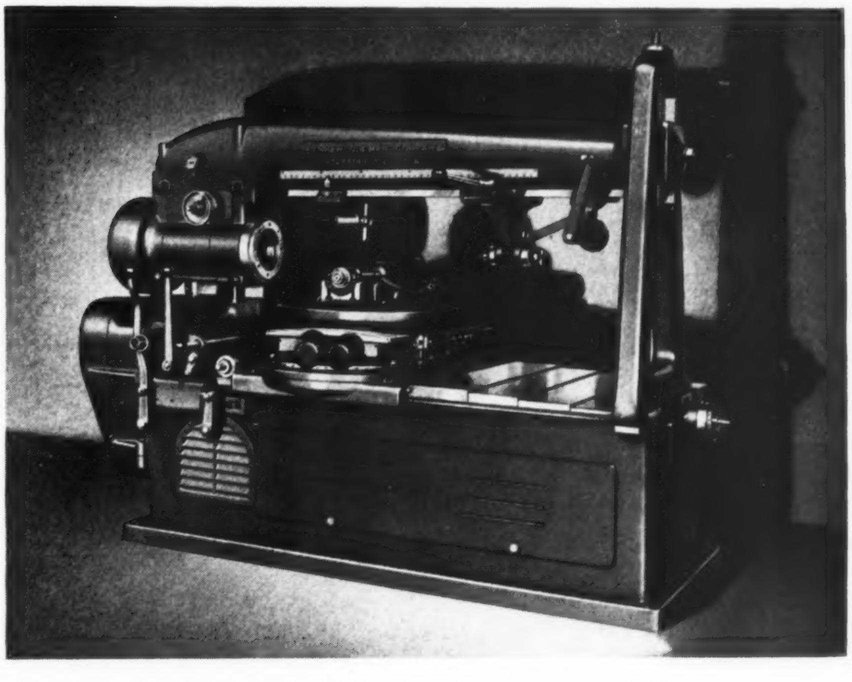
The hob-slide can be swiveled through 360 degrees, and can be set at any angle for hobbing. Tapered hob-spindles can be furnished when it is desired to obtain an unusually fine finish and great accuracy. Hollow type hob-spindles can also be furnished to accommodate shank type hobs or interchangeable hob arbors. This permits hobbing with unusually small-diameter hobs, as, for example, when hobbing a gear close to a shoulder. 51

Haynes Stellite Star J-Metal Cutting Alloy

A cobalt-chromium-tungsten metal cutting alloy known as Haynes Stellite Star J-Metal has been developed by the Haynes Stellite Co., Kokomo, Ind., a unit of Union Carbide and Carbon Corporation. This cutting alloy replaces the former grade of Haynes Stellite J-Metal tool alloy. Thorough tests on production jobs have proved the new tool material to be a substantial improvement over the former J-Metal grade in life between grinds.

Star J-Metal is recommended for all machining operations now being performed with the original Haynes Stellite J-Metal tools on cast iron, semi-steel, steel, and other materials. The new cutting tools can be operated under the same conditions as the original grade, and are ground with the same wheels at the same wheel speeds and feeds. In addition to longer tool life between grinds, higher speeds and feeds are frequently possible.

The new alloy is available in all of this manufacturer's standard tool bit sizes, both squares and flats, and in many standard and special blade designs and sizes; also in the form of standard welded-tip tools and in many special tool designs. 52



Barber-Colman Improved Gear-hobbing Machine

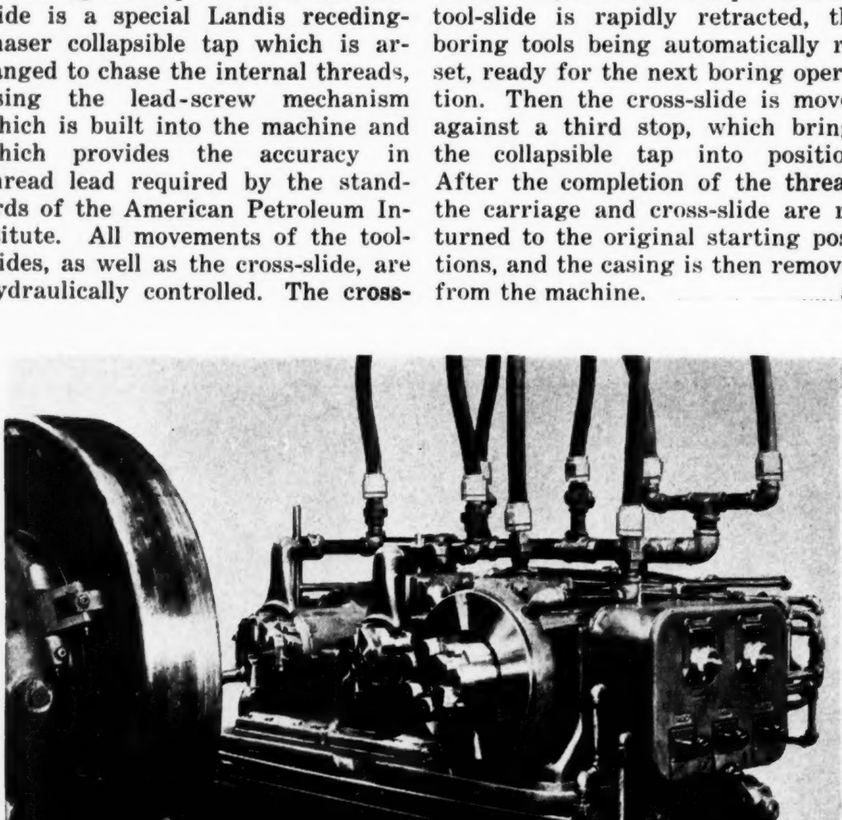
To obtain additional information on equipment described on this page, see lower part of page 212.

Landis Recessing, Boring, and Tapping Machine for Integral-Joint Casing

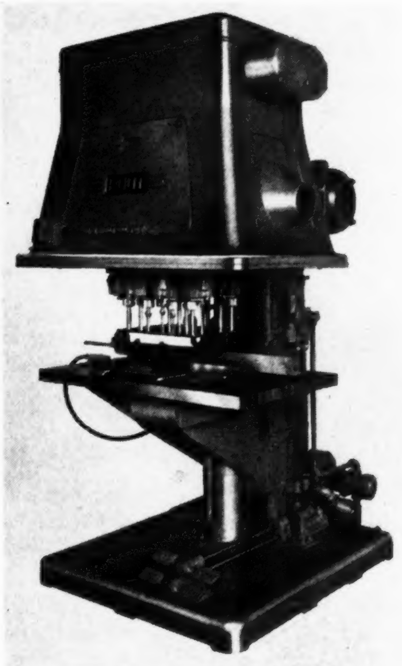
The recessing, boring, and tapping machine here illustrated has been designed by the Landis Machine Co., Inc., Waynesboro, Pa., for completely machining the internal or tapped end of integral-joint casing at one chucking. The machine is similar to the Landis mill type receding-chaser pipe-threading and cutting-off machine, but the conventional carriage and receding-chaser pipe-threading die-head have been replaced by a special carriage on which is mounted the recessing, boring and tapping tools. The tool-slides, of which there are three, are mounted on a cross-slide which can be indexed to bring any one of the tool-slides into the working position.

One tool-slide finishes the recess, faces the end of the casing, and chamfers three surfaces at the end of the casing. The second tool-slide finishes the taper bore preparatory to tapping, using a receding action of the cutters for accurately producing the taper. The third tool-slide is a special Landis receding-chaser collapsible tap which is arranged to chase the internal threads, using the lead-screw mechanism which is built into the machine and which provides the accuracy in thread lead required by the standards of the American Petroleum Institute. All movements of the tool-slides, as well as the cross-slide, are hydraulically controlled. The cross-slide is hydraulically locked into position on the carriage when any one of the tool-slides is in action. The operating controls are centralized on a panel at the front of the machine, from where the operator can also observe the tools in action.

The casing to be machined is placed in the spindle against the arm of the pneumatically operated work-stop, and is gripped by the front and rear pneumatic chucks mounted on the spindle of the machine. The recessing-tool slide is then advanced rapidly toward the casing and automatically brought to a predetermined rate of feed just before the tools enter the work. At the completion of the operation, this tool-slide is rapidly retracted and the cross-slide is then indexed, bringing the boring-tool slide into position. The boring-tool slide is rapidly advanced toward the work and automatically brought to a predetermined rate of feed as the tools enter the cut. At the end of this cut, the tools collapse and the tool-slide is rapidly retracted, the boring tools being automatically reset, ready for the next boring operation. Then the cross-slide is moved against a third stop, which brings the collapsible tap into position. After the completion of the thread, the carriage and cross-slide are returned to the original starting positions, and the casing is then removed from the machine. 53



Landis Machine for Recessing, Boring, and Tapping Joint Casing



Multiple-spindle Drilling Machine Built by B. M. Root Co.

Root Multiple-Spindle Drilling Machine

A multiple-spindle drilling machine, known as F400, which is designed for drilling a large number of regularly or irregularly spaced holes over a rectangular area 18 by 36 inches, in steel, aluminum, cast iron, brass, plastics, fiber, and high-density composition materials, has been brought out by the B. M. Root Co., York, Pa.

The table of this machine is hydraulically fed, any feed from 0 to 100 inches per minute being instantly available. Two foot-levers govern the up and down table movements and the "start" and "stop" table action. The machine can be operated with either automatic continuous, or intermittent, feed strokes. It takes but a few seconds to change from one to the other.

A motor mounted on a bracket at the back of the rectangular hood drives the spindle drive-shafts by means of a variable-speed drive. Spindle speeds can be quickly adjusted from 500 to 2500 R.P.M. A push-button station controls the motor. Any spindle may be thrown out of gear by an upward turn of the knurled knob at the top of the spindle.

The distance from the center of the hood to the center of the column is 14 inches; distance from spindle noses to table in its lowest position, 17 inches; maximum number of spin-

To obtain additional information on equipment described on this page, see lower part of page 212.

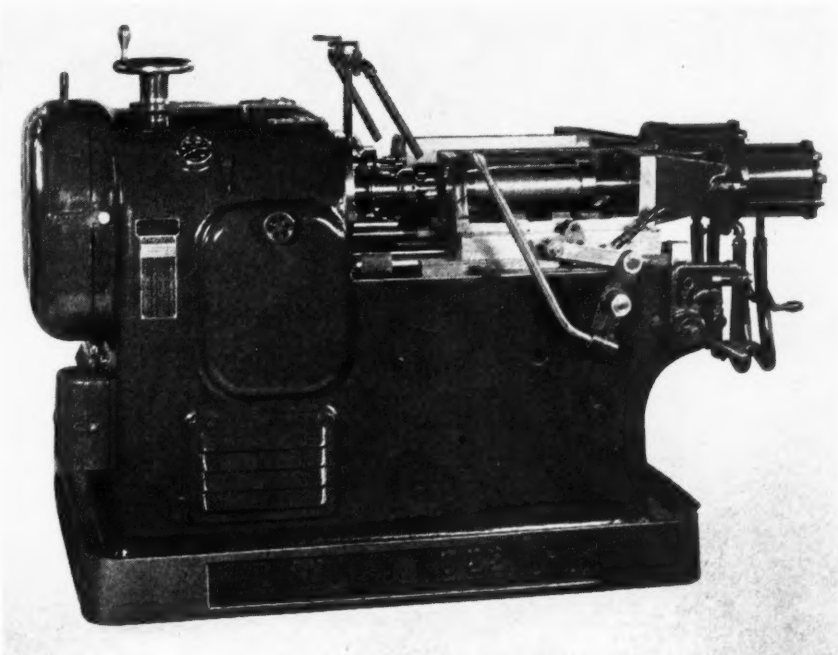
dles the machine will accommodate, 16. The machine has an over-all height of 90 inches; the floor space required is 54 by 66 inches; and the shipping weight, approximately 5000 pounds. 54

Murchey Machines for Tapping and Chamfering Shells

A new series of single- and double-spindle machines designed for tapping and chamfering the nose end of shells has been developed by the Murchey Machine & Tool Co., 951 Porter St., Detroit, Mich. The illustration shows a double-spindle machine with lead-screws for tapping and chamfering the nose end of a 4.5-inch naval high-explosive shell.

The shell holding fixtures are designed with "approximate" hardened and ground locating pads on which to locate the shell within a few thousandths inch of concentricity with the spindle. These pads can be changed to accommodate various sizes of shells. After the shell is approximately located on the pads, it is picked up by a female center actuated by an air cylinder, which forces the shell forward until the nose end is firmly held in a serrated bushing. The latter rigidly supports the shell in alignment for the tapping and chamfering operations. The female centers, serrated bushings, and length of stroke of the air cylinders may be changed to accommodate shells of different sizes.

The spindles are equipped with Murchey Type M ground collapsible taps, which have four reaming tools as well as four chasers. The shells are chamfered with the tap chasers collapsed and the lead-screws disengaged. The carriages are then returned, automatically expanding the chasers for the tapping operation. The lead-screws are then thrown in and the shells tapped in accurate alignment and with accurate lead. 55

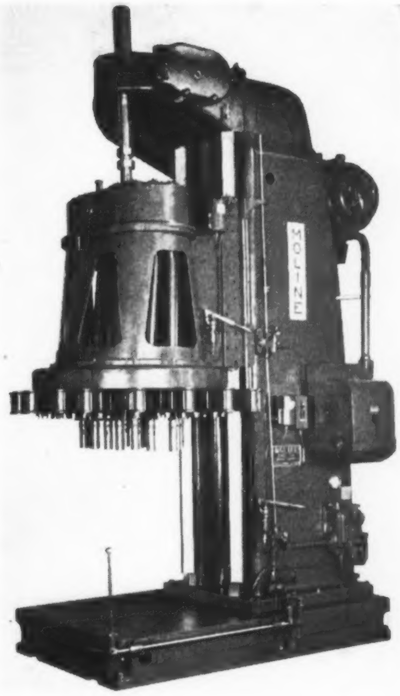


Murchey Double-spindle Machine for Tapping and Chamfering Shell Ends

Lapping Plate for Leakproof Joints

To provide a means for accurately lapping metal-to-metal joints that are required to hold oil, where gaskets, shellac, or sealers of any kind are not used, the Challenge Machinery Co., Grand Haven, Mich., has designed a semi-steel lapping plate with 1/16-inch grooves, spaced 1/2 inch apart, running the full length and width of the surface. These lapping plates are used on crankcases, cylinder heads, etc.

An arc-welded all-steel stand is available with these lapping plates. The stand is provided with closely spaced lock-leveling screws which enable the lapping plate to be kept level at all times. These lapping plates are built in a wide variety of standard sizes ranging from 8 by 8 inches to 52 by 144 inches. 56



Moline Tool Co.'s Hydraulic-feed Drilling Machine

Moline Multiple-Spindle Hydraulic-Feed Drilling Machine

The Moline Tool Co., Moline, Ill., has recently added what is known as the No. 116-U driller to its line of multiple-spindle, hydraulic-feed drilling machines. This machine is similar to others built by the company, but is larger and heavier, and has greater drilling capacity than any of the previous models of comparable design.

A floating splined shaft transmits power from the upper drive-head to the spindle drive-head gear-box, where sixteen spindle drive-gears are located. Each spindle drive-gear is independently adjustable for either of two speeds, or neutral. The upper drive-head contains the pick-off or speed-change gears, as well as the driving spiral gear which meshes with the spiral gear on the upper end of the splined shaft. All gears and bearings in the spindle drive-head gear-box, as well as in the upper drive-head, are automatically lubricated by a circulating oiling system.

Two motors are used on this machine, one to drive the spindles and the other to drive the hydraulic-feed unit. The feed control is mechanical and provides an automatic operating cycle consisting of rapid approach, regular feed, and rapid return, after which the machine stops.

To obtain additional information on equipment described on this page, see lower part of page 212.

The vertical spindle adjustment is 2 1/4 inches; the working stroke of the hydraulic-feed cylinder, 36 inches; and the drilling area, a 30-inch-diameter circle. The over-all height of the machine is 15 feet, and the floor space required, 9 feet by 4 feet 10 inches. 57

Hannifin 150-Ton Hydraulic Straightening Press

A 150-ton hydraulic press with an especially large table to facilitate the straightening of steel castings and similar work has been recently brought out by the Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago, Ill. The base of the press is designed for installation below the floor level to bring the table to a convenient height for the handling of bulky pieces.

In this press, the Hannifin sensitive pressure control is used to insure rapid straightening operations. Finger-tip or light foot-pedal control of the ram movement and ram pressure is provided. The initial movement of the control lever causes the ram to move down rapidly at nominal pressure until it touches the work, at which time it stops. When the control lever is moved beyond the approach position, the ram exerts additional pressure, this pressure being proportional to the distance the control lever is moved. Any required ram pressure up to the capacity of the press is obtained by moving the control lever further down. Releasing the control lever at any point automatically returns the ram to the top position at high speed.

The motor-driven hydraulic power unit is built into the base of the press. The frame of the press is welded, all piping being concealed. The press has a stroke of 20 inches, a gap of 30 inches, a reach of 30 inches, and a table measuring 54 by 96 inches. 58

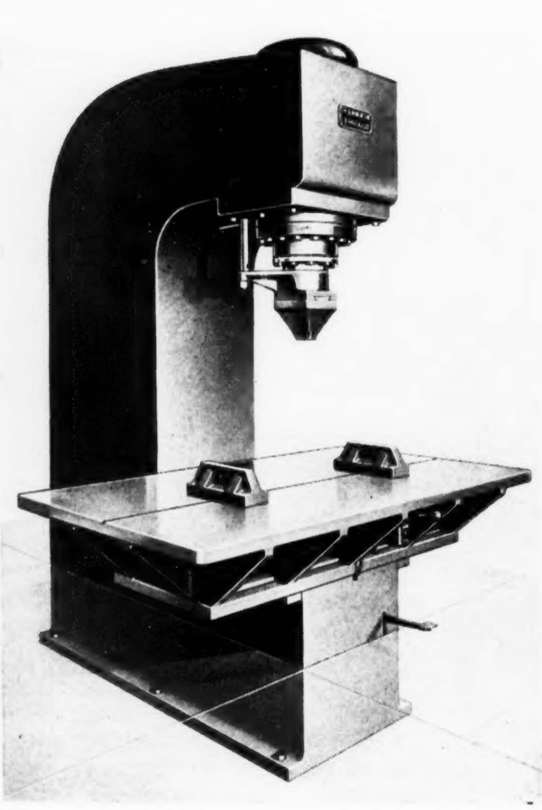
Grant Rotary, Vibrating Type, Shell Riveter

A rotary, vibrating type riveter, known as No. 4A, has been placed on the market by the Grant Mfg. & Machine Co., 90 Silliman Ave., Bridgeport, Conn. This machine is equipped with an automatic mechanism for riveting plugs in 6-inch shells.

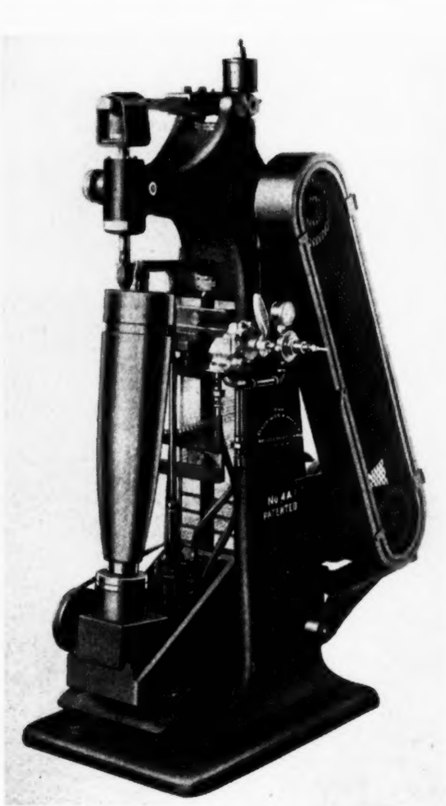
The machine is provided with an air cylinder having a ball-bearing clamp that holds the plug in position during the riveting operation. When the operator depresses the foot-pedal, the shell is automatically revolved, and the riveting hammer simultaneously peens over the shell to hold the plug securely in position. It requires approximately two or three revolutions of the shell to complete the riveting of the plug. The machine is equipped with a three-speed, V type driving pulley; when operated at the highest speed, the shell can be revolved at about twenty revolutions per minute. Approximately 50 pounds of air pressure is required to hold the base plug in position while the machine is in operation. The maximum length of shell that can be handled on this machine is 25 inches. 59

Simmons Honing and Lapping Machines

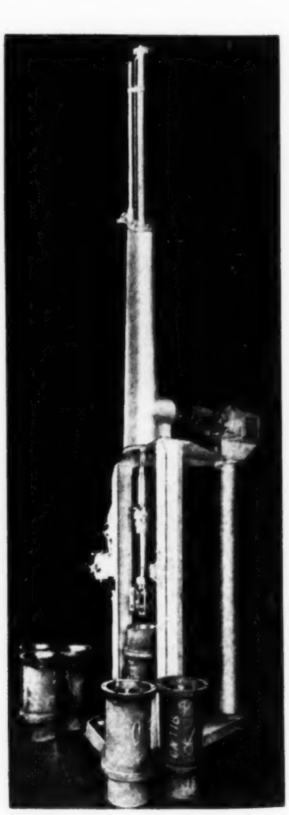
W. H. Simmons & Co., 208-12 Lawrence St., Cincinnati, Ohio, have recently developed a large-capacity honing and lapping machine designed for high-production work. The new machine, known as "Hy-Speed," is made in three sizes having strokes of 36, 48, and 72 inches. The simplicity of operation, it is stated, makes it possible for any workman to turn out accurate work at a high-production rate. An alloy iron cyl-



Hannifin 150-ton Hydraulic Press for Straightening Steel Castings



Grant Riveter for Riveting Plugs in 6-inch Shells



Simmons Honing and Lapping Machine

To obtain additional information on equipment described on this page, see lower part of page 212.

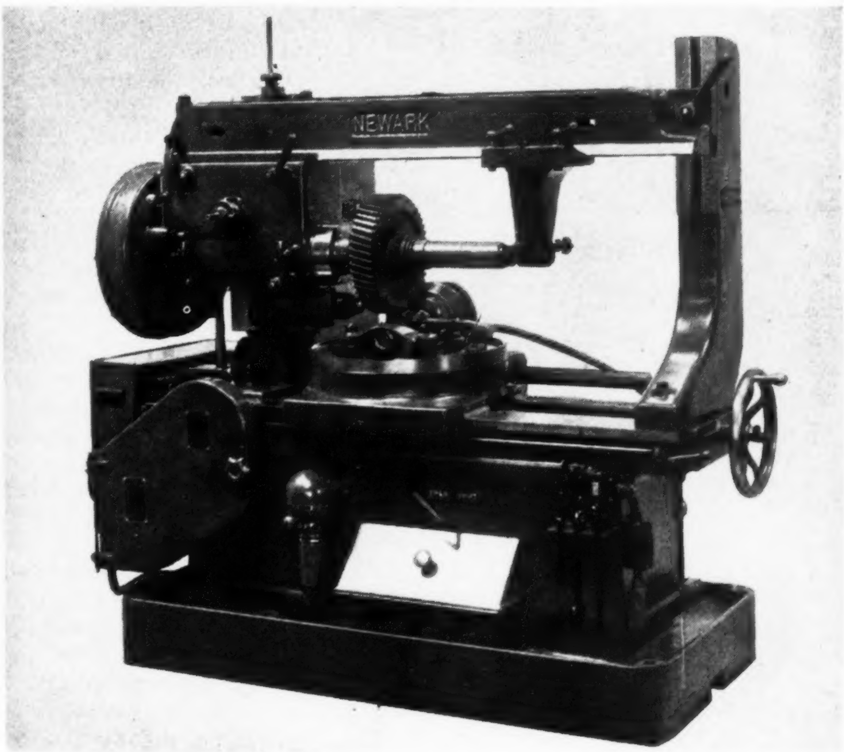
inder 30 inches long with a bore of 10 1/2 inches, which requires the removal of 0.007 inch on the diameter of the bore, for example, is finished in eight minutes actual honing time.

The maximum height capacities under the spindles of the three machines are 60, 75, and 100 inches; the maximum bore sizes that can be honed on these machines are 10, 16, and 24 inches. The two smaller machines have four spindle speeds each; the larger machine, eight. Cylinders up to 28 inches outside diameter can be held on the standard bases of the two smaller machines, while the larger machine will accommodate cylinders up to 44 inches outside diameter. The smaller machines have over-all heights of 15 and 18 feet; the larger machine has an over-all height of 23 feet 4 inches. 60

Newark Gear-Hobbing Machine

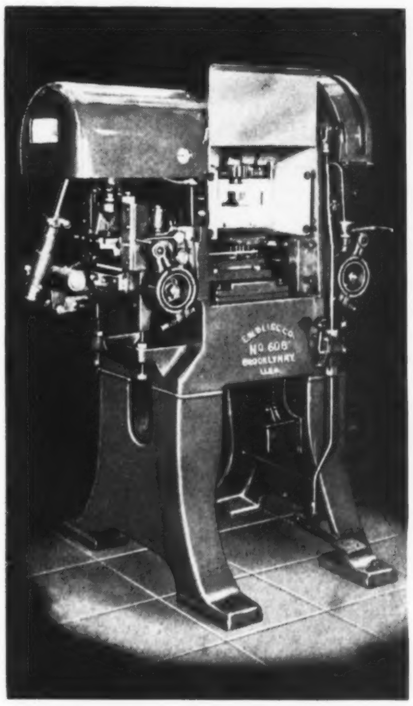
The No. 3 gear-hobbing machine recently placed on the market by the Newark Gear Cutting Machine Co., 69 Prospect St., Newark, N. J., has been completely redesigned. The cutter-spindle is now mounted in Timken bearings, increasing the rigidity of the spindle and insuring permanent accuracy. The rapid-traverse mechanism has a built-in motor, which has eliminated a number of clutches and gears. The rapid-traverse and feed levers are so interlocked that the feed cannot be connected while the rapid traverse is in operation, and vice versa.

All change-gear shafts have multiple splines cut into the solid shaft, insuring continued accuracy of the gears. The main driving motor mounting has been changed, with a saving of about 18 inches of floor space. A V-belt, silent chain, or flat belt can be used with standard stock pulleys or sprockets. The machine is adapted for use in aircraft plants for cutting gears and multiple splines on shafts, as well as for use in gear-cutting shops and machine tool manufacturing plants. 61



Gear-hobbing Machine of New Design Recently Placed on the Market by the Newark Gear Cutting Machine Co.

Bliss High-Production Press



Bliss High-speed Press Capable of Operating at 1200 Strokes per Minute

A high-speed press capable of operating at speeds up to 1200 strokes per minute has been brought out by the E. W. Bliss Co., 53rd St. and 2nd Ave., Brooklyn, N. Y., under the designation No. 608 high-production press. The machine is constructed with a heavy one-piece frame cast from high-test pearlitic iron, and with a light cast-steel slide. Two steel connections and bronze-lined gibbing, combined to maintain alignment of the slide, assure long die life. Electric detectors can be employed in connection with an electric protective trip.

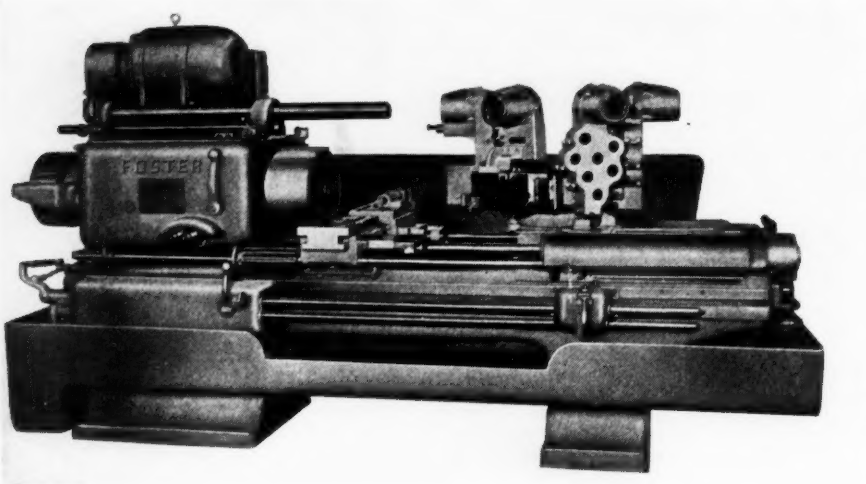
This machine, which is of 8 tons capacity, has a distance from the bed to the slide, with adjustment up, of 7 inches, and a regular stroke of 1/4 inch. The face of the slide, front to back and right to left, is 7 by 10 inches. 62

Weld Controller for Manually or Mechanically Timed Welders

To eliminate the skill required for manually timed welds and assure uniformity of welds, a weld timer-contactor, to be used with any 15- to 35-K.V.A. manually or mechanically timed spot welder, has been brought out by the Weltronic Corporation, 3070 E. Outer Drive, Detroit, Mich. This timer-contactor is available for 220, 440, or 550 welding voltages and for 25, 40, 50, or 60 cycles frequency. The equipment, known as Model 108-53, is adjustable over a range of timing of from 2 to 30 cycles. Two control knobs provide for close adjustment to suit the work being welded.

The entire unit consists of an electronic tube, relay, and magnetic contactor, enclosed in a spring-hinged cover case measuring 11 by 13 by 30 inches. 63

To obtain additional information on equipment described on this page, see lower part of page 212.


No. 1-F Fastermatic Built by the Foster Machine Co.

Improved Foster Fastermatic

A No. 1-F Fastermatic, which, while similar in construction to the 2-F Fastermatic brought out a few months ago, but having many new design features, has been placed on the market by the Foster Machine Co., Elkhart, Ind. This machine is applicable to both long- and short-run lots. It has twenty-seven spindle speeds from 22 to 332 R.P.M., arranged in nine sets of three automatic changes; any group of speeds can be obtained by the proper set of pick-off gears. Higher ranges are available when required. The design is such that there is always a positive application of power to the spindle during the spindle speed changes.

The automatic spindle speed changes are selected by means of the spool in front of the machine which has buttons that are readily applied or adjusted by the operator. The actual changes are made by hydraulically operated multiple-disk clutches. Speed changes may be made during the cut or at the end of the cut, as desired. The spindle speed changes can be used with any of the turret faces or as many as required. When no automatic speed changes are required, the buttons are simply removed from the spool. Hydraulic feeds provide a separate independent feed for each turret station.

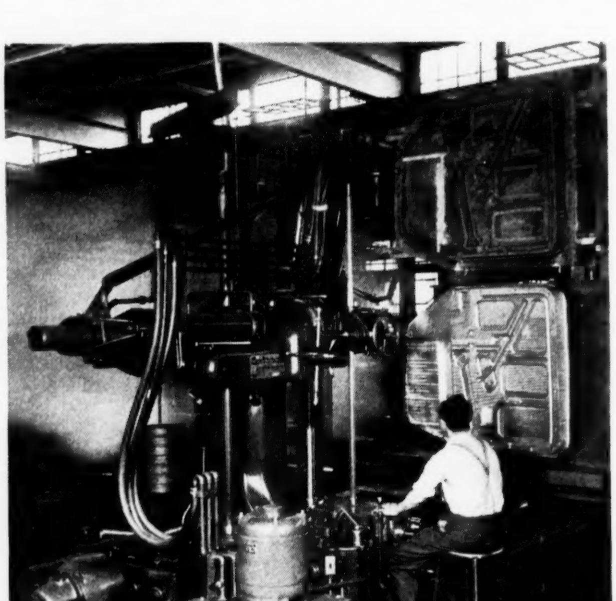
The hexagon turret may be indexing or non-indexing, as desired. The front and rear cross-slides are independent of each other. Either or both of these slides can be used in conjunction with as many of the turret stations as necessary. The machine may be hand-operated during set-ups. The principal dimensions are as follows: Swing over bed, 21 inches; total distance from spindle nose to turret face, 41 11/16 inches; floor space, 40 5/8 by 122 inches; approximate weight, 7000 pounds. 64

Denison Hydraulic Straightening Press

A hydraulic straightening press known as Type DLSC2, which is available in 25- and 50-ton capacities, has been brought out by the Denison Engineering Co., Chestnut and Water Sts., Columbus, Ohio. The main difference between this new type and the hydraulic presses previously placed on the market, which have been illustrated and described in MACHINERY, is in the design of the frame. The height of the frame has been reduced and its appearance improved. There are also improvements in the control mechanism, increasing the efficiency of the equipment. 65

Turchan Follower Duplicator

A new follower duplicator has been developed by the Turchan Follower Machine Co., 8259 Livernois Ave., Detroit, Mich., as an aid in making forming dies and in reproducing forms where the success of the operation in the past has depended on human skill. This duplicator is a hydraulic attachment which can be adapted to practically all types of machine tools—boring mills, milling machines, lathes, planers, shapers, and grinding machines.

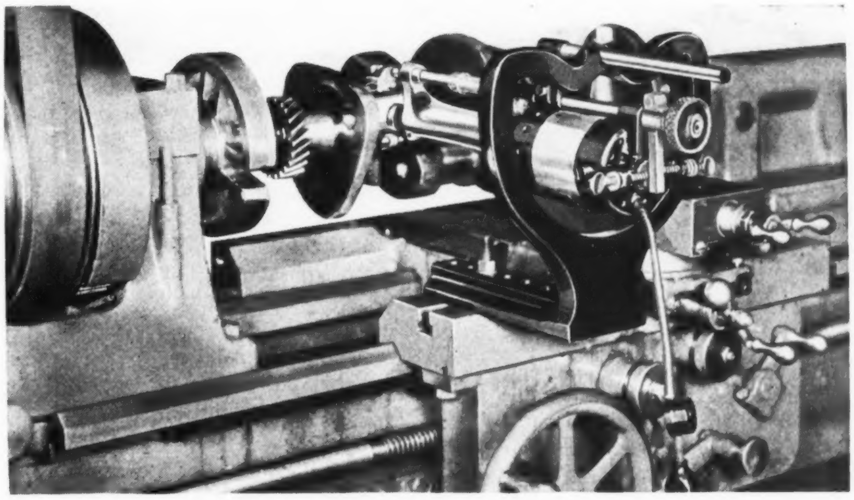

Turchan Duplicator Applied to a Horizontal Boring Machine

The illustration shows such a hydraulic duplicating attachment applied to a horizontal boring machine. The tool is controlled by hydraulic cylinders attached to the housing, the bar movement being actuated through connecting-rods. The tracer valve allows oil to pass into the cylinders in varying amounts, thereby causing the cutter to move in and out to conform with the model. The slightest rise or drop in the surface of the model is responded to by the tracer control valve. Ease of operation of the device, combined with simplicity, enables the operator to handle it with satisfactory results after a comparatively few hours practice.

These duplicating attach-

To obtain additional information on equipment described on this page, see lower part of page 212.

ments are built to be applied to very large machines, as well as to small, high-speed milling heads, where small cavities are reproduced by end mills, and where the pressure of the tracer tip on the model is as little as one ounce. 66



The Winona Tool Mfg. Co.'s Crankshaft Grinder Used on a Lathe

"Intheblok" Crankshaft Grinder

A fast and accurate precision tool known as the "Intheblok" crankshaft grinder, designed for resizing and refinishing hard, battered, and out-of-round crankpins without removing the shaft from the engine, has been brought out by the Winona Tool Mfg. Co., Inc., Winona, Minn. With this new equipment, crankpins can be ground to size within a tolerance of 0.0005 inch, regardless of the condition of the shaft. A stabilizing attachment makes it impossible to grind the crankpin "out of line" with the main bearing.

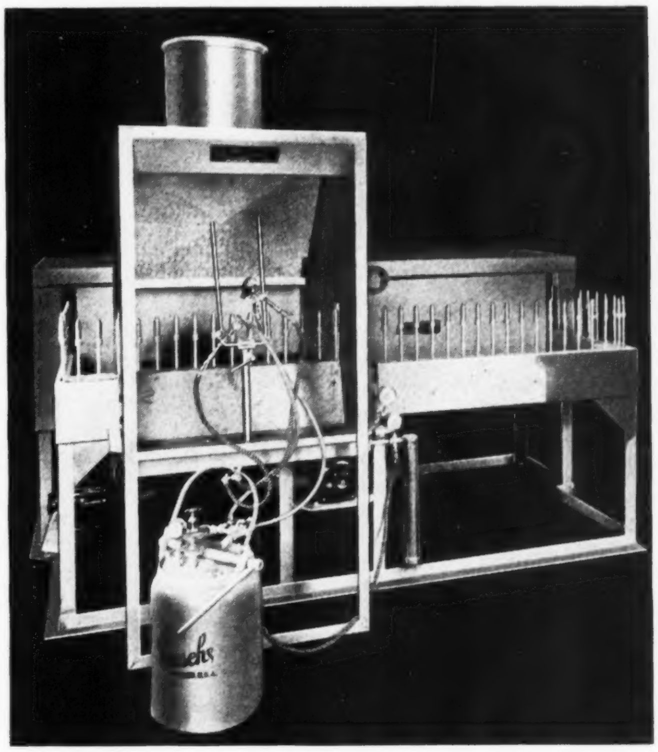
A rear-wheel drive unit, designed to permit the attachment to be operated from power taken from the rear wheel of an automobile, is available. The attachment can be supplied for use on a lathe in the manner indicated in the illustration. Adjustable stops control the length of the grinding wheel travel to suit various widths of crankpin bearings. 67

Paasche Automatic Air-Finishing and Drying Units for Shells

An automatic air-finishing and drying unit for applying black paint to 20-millimeter shells at the rate of 17,000 in an eight-hour day has been brought out by the Paasche Airbrush Co., 1909-1923 Diversey Parkway, Chicago, Ill. This unit is equipped with a steel roller chain which supports 164 revolving spindle assemblies; automatic "off" and "on" control for the airbrushes; and variable-speed pulley and reducer to operate the chain at speeds of from 4 to 9 feet per minute. All of the mechanism is mounted on an electrically welded structural-steel frame.

The unit is approximately 8 feet long by 3 feet 9 inches wide, and includes a drying oven 8 feet long by 1 foot 8 inches wide by 1 foot 6 inches high. The oven is insulated with rock-wool and provided with an electric strip heater, thermostatically controlled.

The unit is equipped with automatic airbrushes; "Clamptight Cover" pressure-feed material tank; water, oil, and dirt separator to provide clean dry air; regulator and gage; exhaust unit with explosion-proof motor; spray booth; and duct to the fan.



Paasche Automatic Equipment for Applying Paint to 20-millimeter Shells

The Paasche Airbrush Co. has also brought out automatic air-coating units for applying a coat of black lacquer to parts for various other sizes of shells. 68

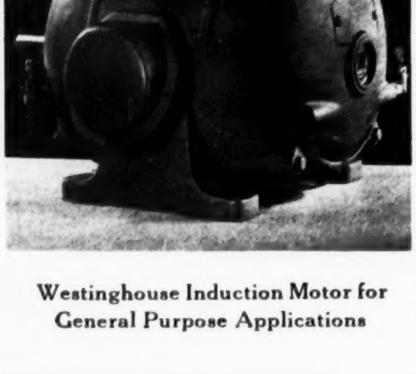
Ingersoll-Rand Light-Weight Grinder and Drills

The Ingersoll-Rand Co., 11 Broadway, N. Y., has recently added a new "baby" air grinder to its line of pneumatic tools. This grinder—the size 00—weighs only 1 1/4 pounds. It operates at 20,000 R.P.M. at 90 pounds pressure. It is built to take 1 1/2-inch diameter organic bonded or 1 1/4-inch diameter vitrified wheels, and can also be provided with various sizes of collets to take mandrel-mounted grinding wheels or small twist drills.

Although originally intended to be used as a die grinder for tool-room and bench work, it is also being employed for a great many light grinding jobs where metal must be removed from places that would otherwise be difficult to reach.

The company has also brought out a size 0 and a size 00 addition to its drill line. These new sizes weigh 1 1/2 and 2 7/8 pounds, respectively. Numerous attachments are available to adapt these tools for light screwdriving, nut-setting, close-quarter drilling, wire-brushing, sanding, etc. Three different types of handles are provided. 69

To obtain additional information on equipment described on this page, see lower part of page 212.



Westinghouse Induction Motor for General Purpose Applications

Westinghouse Sleeve-Bearing Induction Motor

An open type, sleeve-bearing, squirrel-cage induction motor designed for general-purpose drive applications on machine tools, pumps, auxiliary drives, etc., has been brought out by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. These motors, known as Type CS, are available in ratings from 1/2 to 5 H.P., 875 to 3600 R.P.M., and for operation on 110-, 220-, 440-, and 550-volt, two- and three-phase, alternating-current circuits.

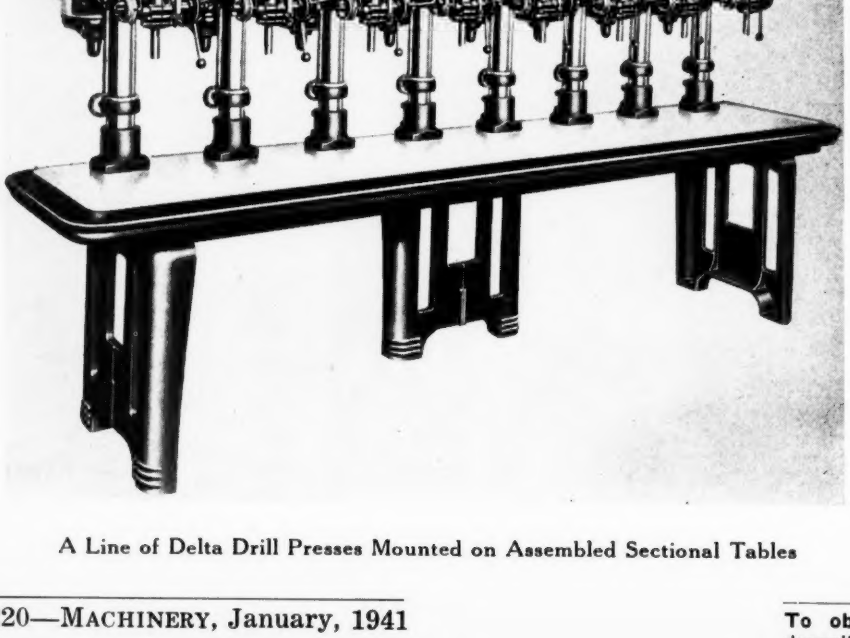
In designing these motors, the aims were to obtain mechanical strength, compactness, and attractive appearance. Rigid cast frames maintain a constant air gap between the stator and the rotor, assuring high-efficiency operation. The frame improvements include new sealed sleeve bearings having a combination vestibule and felt washer seal and a large reservoir capacity. The motors are finished in light machine-tool gray.

New wire insulation provides maximum dielectric strength, toughness, and flexibility. Combination slot cells, with reinforced cuffs, protect the windings from abrasion. The coil ends are taped for reinforcement against strains of full-voltage starting. The motors are dynamically balanced, and the windings are given a high-voltage frequency test. The new motors meet the requirements of the latest N.E.M.A. standards, which became effective October 1. 70

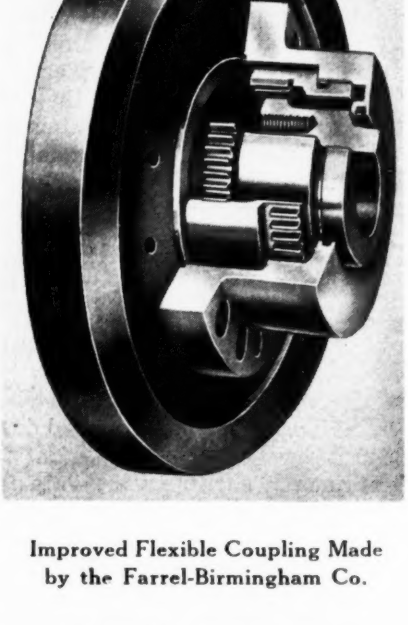
Delta Sectional Drilling Equipment

A sectional drill press that permits the user to arrange his own drilling equipment to fit his exact needs, has been developed by the Delta Mfg. Co., 609 E. Vienna Ave., Milwaukee, Wis. By the use of sectional drill press tables it is possible to build up drill presses with from one to an indefinite number of spindles—all 14-inch or all 17-inch, or any combination of both—with the drilling heads placed to fit the user's requirements. Each table section measures 22 3/8 inches deep by 30 inches wide, with room for two spindles, providing a minimum distance of 15 inches from center to center of the spindles. The tables are ground and fitted for accurate assembly to form, in effect, a solid unit.

The advantages claimed for this type of drilling equipment are that each drilling unit can be made up to fit the job; all drilling and tapping heads can be placed in a row on one continuous production table, thus eliminating transferring the work from one drilling machine to another; and handling, trucking and storage are greatly reduced. 71



A Line of Delta Drill Presses Mounted on Assembled Sectional Tables



Improved Flexible Coupling Made by the Farrel-Birmingham Co.

Farrel-Birmingham "Manger" Coupling

In order to save space, and at the same time obtain full flexibility, the Farrel-Birmingham Co., Inc., 377 Vulcan St., Buffalo, N. Y., has developed a flexible coupling known as the Manger. This coupling is suitable for all the usual flexible-coupling applications and many other applications as well, such, for example, as connecting a shaft to an engine flywheel; connecting one shaft to another that carries an overhung brake-drum; connecting shafts of different diameters; and connecting a driving shaft to a roll or pinion stand when the radial clearance is insufficient for a standard coupling. It can also be used in combination with a magnetic or pneumatic clutch coupling.

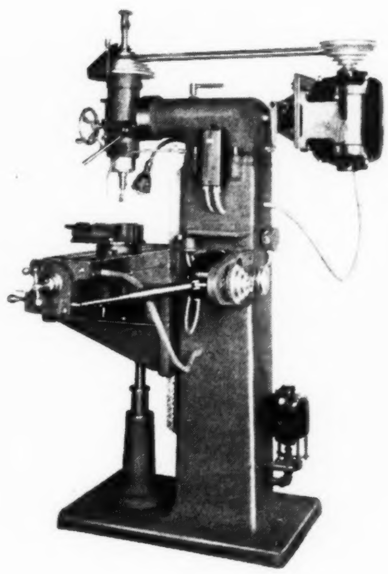
In the Manger coupling, compensation for misalignment is made by an internal sleeve which floats between an externally geared hub and an internally geared covering sleeve. The internal sleeve, which engages the

To obtain additional information on equipment described on this page, see lower part of page 212.

hub and outer sleeve, is free to slide and rock so as to adjust itself for differences in alignment. The driving member can be either the geared hub or the covering sleeve. 72

Improved Midway Vertical Milling Machine

The Midway Machine Co., 2324 University Ave., St. Paul, Minn., has added a new model to its line of Mill-



Midway Milling Machine with Two-speed Motor Drive

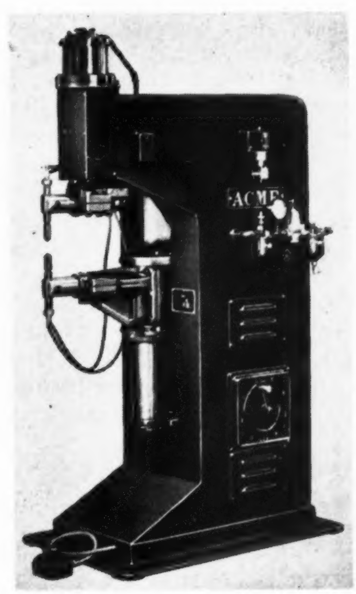
master vertical milling machines. This model is similar in design to the other machines built by the company, the main difference being that it has a two-speed motor and controller. Hence, the new machine is not equipped with a center idler pulley, because the two-speed feature eliminates the necessity for this pulley.

The two-speed machine is intended for applications where rapid speed changes are desired. It is provided with a constant-torque, 575 and 1140 R.P.M., 1-H.P., three-phase, ball-bearing motor with drum type controller. The speed range of the machine itself equipped with this motor is from 130 to 4400 R.P.M., fourteen spindle speeds being available. 73

Acme Spot Welders

A complete line of direct-action, air-operated, press type spot and projection welders has been brought out by the Acme Electric Welder Co., 5621 Pacific Blvd., Huntington Park, Calif. This line is manufactured in transformer capacities of from 30 to 150 K.V.A. In the smaller capacity welders, the throat depths are from 12 to 30 inches; in the larger capacity welders, from 12 to 48 inches. Eight steps of heat regulation are regularly provided, but thirty-two steps can be supplied if required.

The features of the machines include water-cooling of secondary, column, and electrodes; universal double-end reversible horns; positive locking type heat-regulating switch; piston-packed, mirror-ground air cylinder, cushioned on both the up and down stroke; and complete air equipment, including air filter. 74



Acme Direct-action Air-operated, Press Type Spot Welder

Brown Improved "Radiamatic" Pyrometer

The Brown Instrument Co., Philadelphia, Pa., has placed on the market an improved "Radiamatic" pyrometer designed to operate under severe conditions of temperature and vibration. This type of pyrometer is used for applications where vibration breaks the usual types of thermo-couples; where furnaces move or rotate; where the work moves or where thermo-couples cannot be installed; where the temperature is above the thermo-couple range; where furnace atmosphere conditions are unfavorable; and where the maintenance of platinum thermo-couples is costly. The pyrometer is completely self-contained. The detector is sighted on the hot object, moving or still,

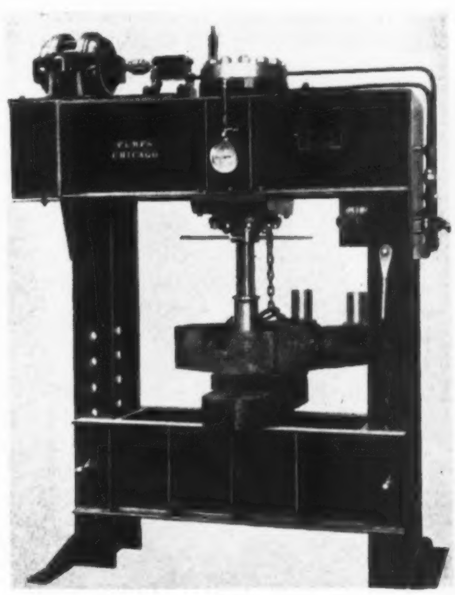
Brown Radiamatic Pyrometer, Showing Lens and Conduit Connection

and continuously measures and controls the temperature of the material itself.

The Radiamatic pyrometer consists essentially of a heat-resisting lens, a compensator, and a thermopile. The heat radiated from the object falls on the lens and is focussed on the thermopile, which generates an electromotive force proportional to the true temperature. The compensator corrects for ambient temperature fluctuations surrounding the detector; and thus only the desired electromotive force developed by the thermopile is translated into degrees of temperature. 75

Elmes Hydraulic Press for General Shop Work

The hydraulic press shown in the accompanying illustration has been developed by the Charles F. Elmes



Elmes Hydraulic Press Designed for General Shop Work

To obtain additional information on equipment described on this page, see lower part of page 212.

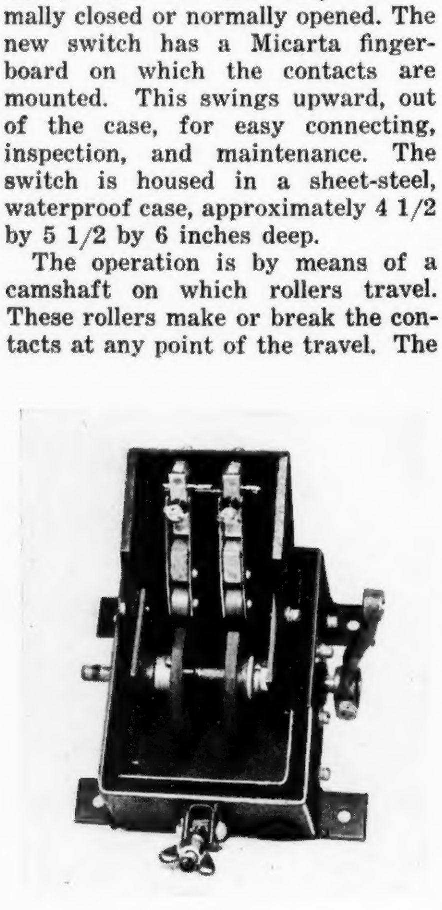
Engineering Works, 230 N. Morgan St., Chicago, Ill., for the purpose of handling a large volume and a wide variety of general shop work at low power cost. Having a 12-inch screw adjustment and a 12-inch stroke of the ram, the press has a total stroke of 24 inches.

The platen is adjustable by means of a ratchet gear. The control is by a single lever; the simple frame construction of all-welded steel gives maximum accessibility. The machine is built in capacities to suit any requirements, beginning with a model powered by a 1 1/2-H.P. motor. 76

Westinghouse Cam Limit Switch

A cam-operated limit switch with contacts arranged to swing open for easy inspection and maintenance has been designed especially to control circuits of hoists, industrial trucks, and similar equipment, by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The new limit switch, known as XC-23, is available in ratings of 2 amperes at 600 volts direct current, and 25 amperes at 110 volts alternating current. It has two contacts, either of which may be normally closed or normally opened. The new switch has a Micarta fingerboard on which the contacts are mounted. This swings upward, out of the case, for easy connecting, inspection, and maintenance. The switch is housed in a sheet-steel, waterproof case, approximately 4 1/2 by 5 1/2 by 6 inches deep.

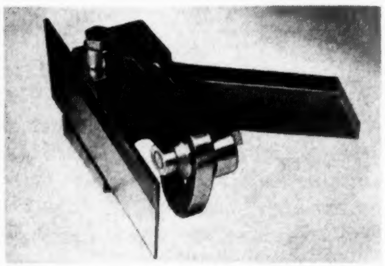
The operation is by means of a camshaft on which rollers travel. These rollers make or break the contacts at any point of the travel. The switch can be actuated either by a revolving shaft coupled to the camshaft or by the movement of an operating lever attached to the camshaft. 77



Westinghouse Limit Switch for Easy Inspection and Maintenance

Murex Welding Rod

An addition to its line of Murex-covered electrodes for manual arc welding has been made by the Metal & Thermit Corporation, 120 Broadway, New York City. The new electrode, known as Murex Alternex, is designed especially for use with transformer type alternating-current welding equipment, and is said to be suitable for use in all positions, including vertical "down welding." In the smaller sizes, it can also be used to advantage in welding light-gage steel. 78



Anthony Cutting-off Tool of Improved Design

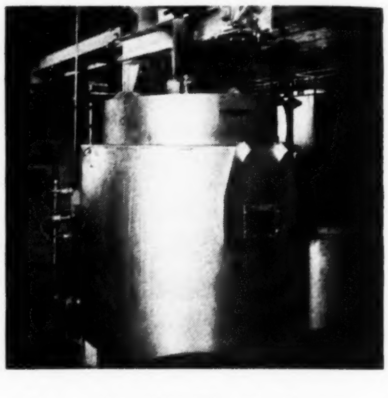
Anthony Cutting-Off Tool

A cutting-off tool which is designed to give the blade maximum support for cutting large stock, and which has a safety slip arrangement to prevent breakage of blades and machinery, has been placed on the market by Anthony Cutting-Off Tools, P. O. Box 1684, San Antonio, Tex. While this tool was designed for cutting off large-diameter stock, with heavy feeds, it is also adapted for cutting off small stock.

This tool is made in six sizes which hold cutter blades ranging in size from 3/32 by 5/8 by 5 inches up to 3/16 by 1 1/8 by 9 inches. The regular shank sizes range from 1/2 by 1 1/8 inches to 3/4 by 1 3/4 inches, but holders can be furnished with shanks made to order. 79

General Electric Gas-Carburizing Electric Furnace

A new gas-carburizing electric furnace for casehardening steel parts has been developed by the General Electric Co., Schenectady, N. Y. A



Gas-carburizing Electric Furnace Built by the General Electric Co.

hydrocarbon gas (in this case propane) circulated rapidly through the charge is used as a source of carbon instead of a solid carbon compound. Since the gas is uniformly distributed in the furnace, a case of uniform thickness is formed on every surface, regardless of its position in the charge.

The furnace can be controlled automatically to reproduce any carburizing treatment time after time. Available operating data show that very high savings are being made through the use of this furnace. These savings are possible because of the shortened carburizing cycle, the elimination of packing material and the packing and unpacking process, and the improvement in the quality and uniformity of the work. 80

Trico Unbreakable Thermal Bottle Oiler

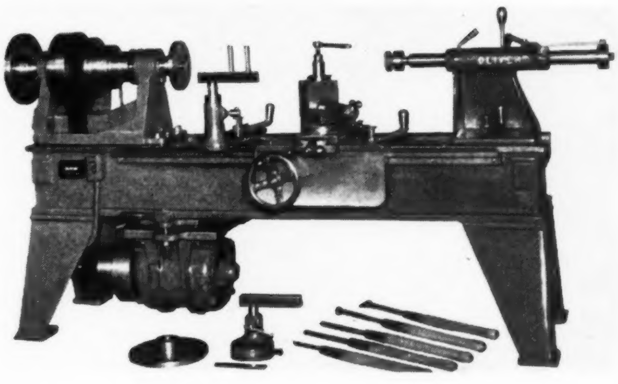
A visible, unbreakable bottle oiler, intended to replace ordinary oil-cups, has been developed by the Trico Fuse

Visible Bottle Oiler Made by the Trico Fuse Mfg. Co.

To obtain additional information on equipment described on this page, see lower part of page 212.

Mfg. Co., 2948 N. 5th St., Milwaukee, Wis. This oiler automatically lubricates solid, wick, or waste-packed bearings. If a slight temperature rise occurs in the bearing, the oiler discharges a few drops of oil. As soon as the bearing receives this oil, it cools, and the feeding stops automatically.

The oiler is provided with an adjustable feed. By a simple turn of the thermo-dome, a port-hole opens or closes, regulating the flow of oil. The oiler is made in 1-, 2-, and 4-ounce capacities. It is quickly installed without special tools. 81



Oliver Machinery Co.'s Large-size Spinning Lathe

H. O. Bates Marking Machine for Round and Flat Surfaces

A marking machine for both round and flat work, including tapered parts, has been developed by H. O. Bates, 251-257 N. Broad St., Elizabeth, N. J. This machine is adapted for marking names, specification numbers, and other information on a variety of shapes and sizes. The marking area is sufficient to take parts up to 10 by 4 inches.

For round pieces, the part is rolled as the flat die impresses the marking, whereas flat parts are marked with a roller die. The holders will take steel type or solid lettering dies, and are quickly interchangeable for any marking. Several of these machines are being used for marking aicraft parts in well-known plants in that industry. 82

Oliver Metal-Spinning Lathe

A metal-spinning lathe in 16-, 20-, 24-, and 30-inch sizes has been placed on the market by the Oliver Machinery Co., Grand Rapids, Mich. The three smaller sizes of this machine are equipped with a 3-H.P., 1200 R.P.M. motor, and the 30-inch size with a 5-H.P. motor. The control is of the push-button magnetic type, wired to the motor and ready to run. The spindle speeds are approximately 1200, 1600, 2000, and 2400 R.P.M.

The illustration shows the 24-inch machine. The machine is regularly built with a plain bed or with a hand-feeding carriage having a compound swivel rest and tool-holder. It can also be built with various types of tailstocks, such as plain, set-over, or heavy-duty production types. 83

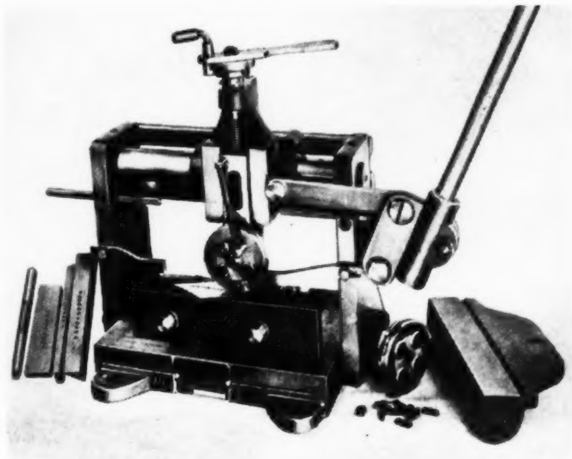
"Little Blacksmith" Punches, Shears, and Notchers

An addition has been made to the "Little Blacksmith" line of punches, shears, and notchers which has previously been illustrated and described in the technical press. The builder, J. F. Kidder Mfg. Co., Inc., 426 Colchester Ave., Burlington, Vt., designates the new model the No. 42. Built in arc-welded steel-plate construction, it weighs 300 pounds. The new machine has a punching capacity up to 2 inches diameter in 1/8-inch mild steel, and the depth of the throat is 7 inches. It can be equipped with a number of attachments for increasing its range.

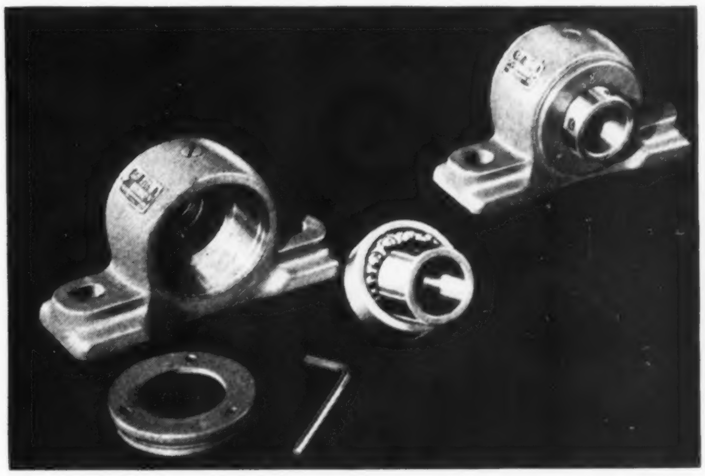
This machine can be equipped for punching holes up to 5 inches in diameter; for shearing or notching angle-iron up to 2 inches by 2 inches by 1/4 inch; for shearing flat stock up to 7 inches by 3/8 inch; for square notching up to 4 by 4 inches by No. 12 gage; and for 90-degree notching up to 5 by 5 inches in 1/16-inch stock. 84

Ahlberg Improved Pillow Blocks

The Series EC pillow blocks made by the Ahlberg Bearing Co., 3052 W. 47th St., Chicago, Ill., are now being equipped with Neoprene seals to protect the bearings and retain the lubricant. These labyrinth type seal rings turn with the shaft and float in the housing. The complete units consist of self-aligning, precision ball bearings mounted in Parkerized, one-piece housings. They are adapted for light and normal service where dependable, yet inexpensive, bearings are required. 85

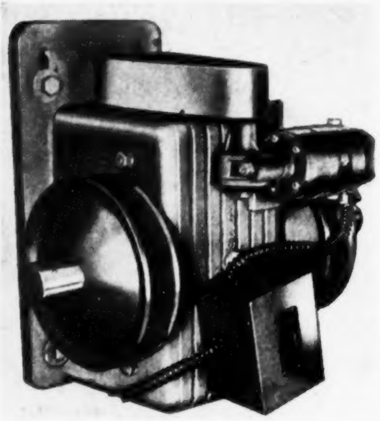


H. O. Bates Marking Machine for Round and Flat Parts



Ahlberg Ball-bearing Pillow Blocks Provided with Neoprene Seals

To obtain additional information on equipment described on this page, see lower part of page 212.



Electric Control for "Select-O-Speed" Transmissions

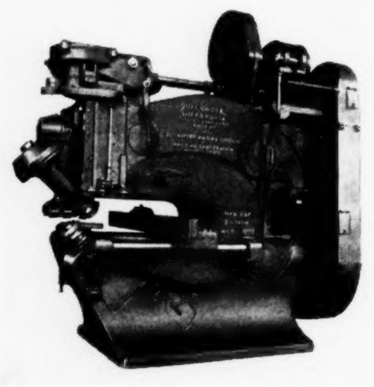
Motorized Control for "Select-O-Speed" Transmission

A new series of "Select-O-Speed" transmissions equipped with electric motorized control has been brought out by the Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill. This series supplements the standard line, which has capacities ranging from fractional to 7 1/2 H.P., and which is equipped with lever type and handwheel control. The electric control is especially adaptable for machine tool applications where the drive must be mounted either behind or inside the machine. A two-button switch controls the speed. Changes in speed adjustments are made by simply pushing either the fast or slow button and keeping it depressed until the desired speed is obtained. This control is available on Select-O-Speed transmissions of sizes from 1 1/2 to 7 1/2 H.P. capacity. 86

A Set of Gage-blocks Made by Jansson Gage Co.

Quickwork Rotary Shear

A Model 62-A rotary shear has been added to the line of shears built by the Quickwork-Whiting Division of the Whiting Corporation, Harvey, Ill. This machine embodies the principles applied in other Quickwork shears, but has been designed especially for cutting mild steel, in thicknesses up to 2 inches, in the shipbuilding, tank building, and other industries engaged in armament work. The new shear has more power, greater speed, and higher production capacity than the Quickwork shear heretofore placed on the market.



Quickwork Shear for Cutting Mild Steel Plates up to 2 Inches Thick

For straight cutting of 2-inch plates having a tensile strength of 65,000 pounds per square inch, a shearing speed of 50 feet a minute is possible. The machine will also shear 1-inch plates with a tensile strength of 130,000 pounds per square inch at the same rate of speed.

Attachments are available that make it possible to cut circles and irregular shapes at speeds comparable to those used in straight slitting. Beveling and joggling operations can also be performed. 87

Jansson Precision Gage-Blocks

The Jansson Gage Co., 25820 Orchard Lake Road, Farmington, Mich., has placed on the market gage-blocks for which great accuracy is claimed. The standard set shown in the illustration contains eighty-one blocks from which combinations can be built up from 0.200 inch in steps of 0.0001 inch. The blocks, made from alloy steel, are stabilized by heat-treatment, eliminating changes in the sizes. The manufacturer announces that the blocks can be obtained in three grades of accuracy, namely, 0.000008 inch per inch; 0.000004 inch per inch; and 0.000002 inch per inch. Blocks that are chromium-plated to insure longer life are also available. 88

* * *

Australian Machine Tool Industry

The manufacture of machine tools is expanding rapidly in Australia. The Commonwealth Government has ordered machine tools from domestic manufacturers valued at $6,500,000, twenty-eight machinery builders being represented.

At the beginning of the war, there was only one Australian firm that manufactured lathes, and two firms that made power presses. For machine tools, Australia depended entirely upon the United Kingdom, the United States, and Germany. The Government, therefore, decided to initiate an ambitious program for the manufacture of machine tools and other machinery. A firm that has been organized within the year is now building cartridge machines. Power presses with capacities of from 700 to 5000 tons are successfully built, and engine lathes up to 24-inch swing with beds 30 feet long are manufactured, as well as turret lathes and shell lathes. Drilling machines, milling machines, shapers, some grinding machines, hacksaw machinery, and cold saws are also being built.

* * *

Cellophane bags are now being used in a machine tool plant for keeping small parts in the stockroom. By being placed in cellophane bags, the small parts are kept by themselves, but are visible to anyone inspecting the stock on hand. Since the average machine-building plant must keep thousands of small parts in stock, the simplicity of the use of cellophane bags is likely to become generally appreciated. The Warner & Swasey Co., Cleveland, Ohio, has been using bags made by the Dobeckmun Co. of that city, for about a year, and it is understood that the system is working out to satisfaction.

To obtain additional information on equipment described on this page, see lower part of page 212.

CINCINNATI SHAPERS
Multiple Punching
Cincinnati Press Brakes are widely used for multiple or gang punching. These jobs range from heavy steel plate to thin aircraft aluminum alloys.
Write for Recommendations on Your Job
THE CINCINNATI SHAPER CO.
SHAPERS · SHEARS · BRAKES
CINCINNATI, OHIO.

Production Capacity of the Grinding Wheel Industry

The following information on the production capacity of the grinding wheel industry has been prepared by the Grinding Wheel Industry Defense Committee and has been approved for publication by the Machine Tool Division of the National Defense Commission. During the last six months, a great deal has been said about the machine tool industry's place in the Defense Program, but it is just as important to plan ahead in regard to accessories and supplies used in conjunction with machine tools.

Machine tools must themselves be tooled up for the jobs they are to do —turret lathes must have "tooling," and grinding machines must have grinding wheels. Tools and wheels wear out when used in manufacturing processes, and the supply must be planned for on the basis of the expected production of arms, tanks, trucks, shells, and engines. Anticipating the needs of a planned production schedule, the grinding wheel industry established a Defense Committee in June, 1940. This committee proceeded immediately to make a production capacity survey, the results of which show that the industry has ample reserve manufacturing facilities to keep well ahead of the defense materials production schedule. A plan has been worked out and put into operation that will insure an adequate flow of wheels and other abrasive material, not merely in total volume, but in the specific shapes and sizes required by individual manufacturers.

The grinding wheel industry has at the present time a productive capacity 80 per cent in excess of its current rate of operation, and a survey shows that an all-time peak production can be exceeded by at least 100 per cent on six months' notice. Grinding wheel users are being assured that their needs will be met, but are being asked to cooperate by ordering well in advance of the time the wheels are to be used. They are likewise asked to cooperate by restricting the quantities of their orders to the actual known demand at the moment, so that an orderly flow of abrasives to the users will not be impeded by too large inventory purchases.

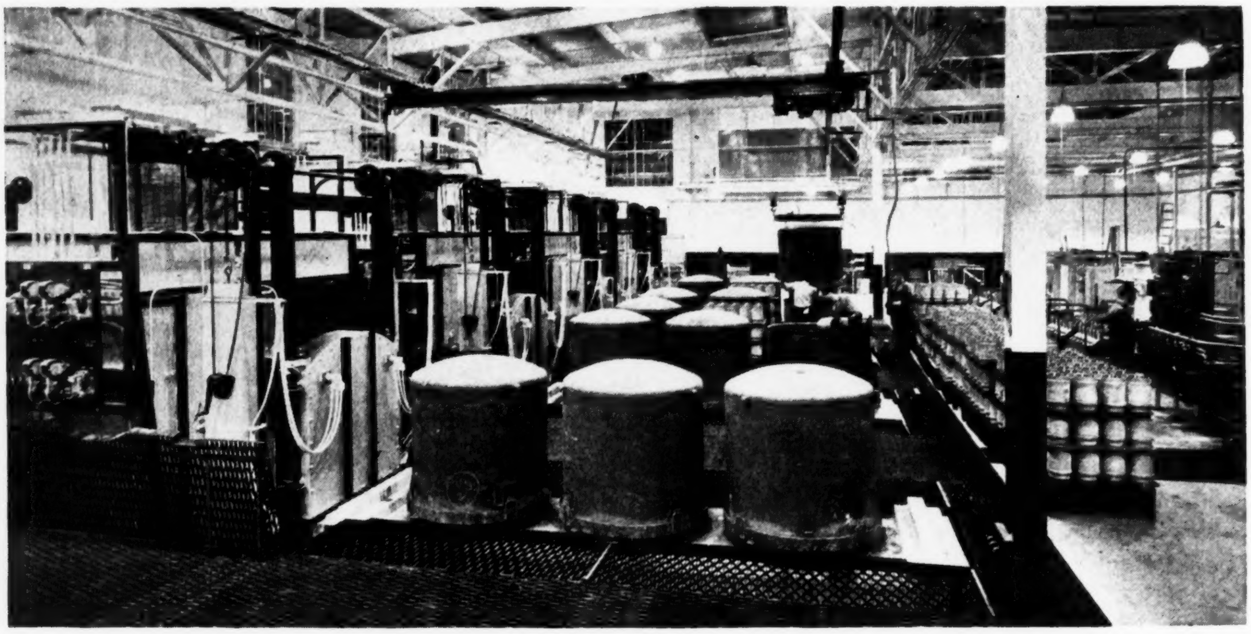
Million-Dollar Installation of Movable Nitriding Furnaces

Seven nitriding furnaces, capable of treating over 2500 cylinder barrels for aircraft engines every three days, have recently been installed in one of the plants of the Wright Aeronautical Corporation at Paterson, N. J. Designed for mass production, these furnaces are mounted on rails in a manner to permit continuous use. The rails provide for moving each furnace back and forth between two stations. Both stations are equipped with three receptacles into which the cylinder barrels are placed for the nitriding process. When the cylinder barrels in the three receptacles at one station have been nitrided, the furnace is moved along the rails to the second station and over the three other receptacles, which have been loaded with cylinder barrels in the meantime. With this arrangement, no furnace time is lost in loading, cooling, and unloading the cylinder barrels.

The nitriding process requires about fifty hours, ten of which are consumed in bringing the furnace and the cylinder barrels up to the proper temperature. The furnace temperature is then held at 1000 degrees F. for thirty hours. The remaining ten hours are consumed in cooling the parts sufficiently to permit unloading from the containers.

Accurate temperature control is obtained by the use of electric eyes sensitive to variations in temperature of one degree. The slightest lowering in temperature deflects a light beam that is normally focussed on a selenium cell and causes a flow of electric current which operates controls to increase the temperature as required.

This battery of nitriding furnaces, which is believed to be the largest installation of its kind in the world, was installed at a cost of more than one million dollars.



General View of the Wright Nitriding Department in which Seven Furnaces have been Installed which can be Moved Back and Forth between Two Stations so as to Permit Continuous Use

The Cincinnati Bickford

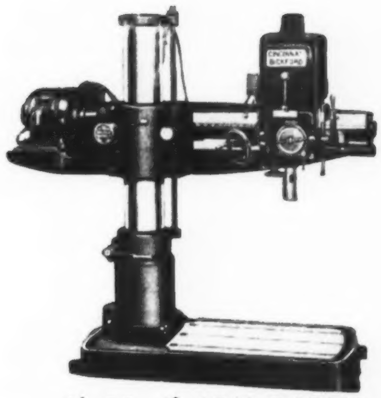
SUPER SERVICE

Upright and Radial

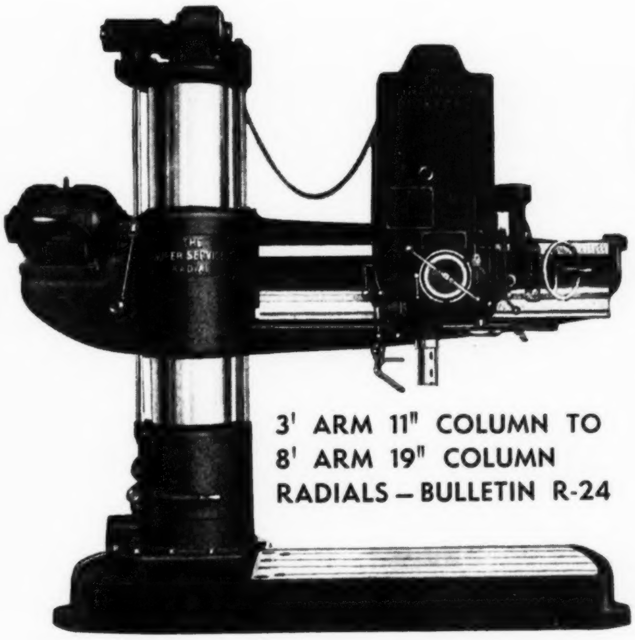
METAL DRILLING MACHINERY

Productivity, Capacity, Adaptability, Reliability, Accuracy, Convenience and Economy are the intangible components that give the Cincinnati Bickford line of drills the appropriate name of SUPER SERVICE.

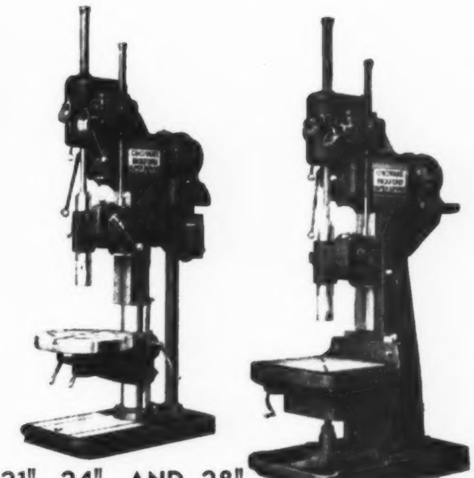
Examine the possibilities of the machines shown here and for further information send for any or all of the Bulletins pertaining to the machines that interest you.



3' OR 4' ARM RADIAL
WITH 9" COLUMN
BULLETIN R-21-A



3' ARM 11" COLUMN TO
8' ARM 19" COLUMN
RADIALS — BULLETIN R-24



21", 24", AND 28"
ROUND AND BOX
COLUMN UPRIGHTS
BULLETIN R-25

THE CINCINNATI BICKFORD TOOL CO.

OAKLEY, CINCINNATI, OHIO, UNITED STATES OF AMERICA

NEWS OF THE INDUSTRY

California

B. H. Chamberlain, formerly of the Detroit office of Cutler-Hammer, Inc., is now connected with the company's Los Angeles sales staff.

Illinois and Indiana

Gaylord G. Thompson, formerly supervisor of the application and control of carbide tools at the plant of the Gisholt Machine Co., Madison, Wis., has been appointed tool engineer for the McKenna Metals Co., Latrobe, Pa. Mr. Thompson will supervise the installation and use of Kennametal hard carbide tools and blanks in the North Central district. His headquarters will be at the Talcot Building, Rockford, Ill.

Gaylord G. Thompson, Newly Appointed Tool Engineer for McKenna Metals Co.

Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill., announces that the gear steel S A E 4640 is now carried in stock by the company for immediate shipment. The stocks include hot-rolled annealed rounds in sizes from 1 to 5 inches. This steel is also recommended for arbors, boring-bars, spindles, clutches, piston-rods, bolts, studs, ratchets, pins, and other applications where resistance to shock and great toughness are necessary at relatively high hardness.

American Foundry Equipment Co., Mishawaka, Ind., is expanding its facilities by building a 70- by 256-foot addition to its steel fabricating plant, a new steel storage building, and an enlarged office building.

Michigan

George Mann, Jr., has been appointed to head the management of the A C Spark Plug Division of the General Motors Corporation, Flint, Mich. He succeeds L. Clifford Goad, who has been advanced to the position of assistant to the vice-president in charge of the General Motors Corporation's accessory divisions. Mr. Mann is a native of Baltimore, Md., and became connected with the A C Spark Plug Division in 1919.

Crobalt, Inc., Ann Arbor, Mich., has completed a new plant for the manufacture of Crobalt, a non-ferrous cutting tool alloy. The company will begin operations early in the year in the new Ann Arbor plant, which is located thirty-five miles from Detroit, where the company's business has been conducted since 1934. The new plant, of brick and steel construction, provides about 6000 square feet of floor space.

Empire Tool Co., 8790 Grinnell Ave., Detroit, Mich., is now manufacturing the Luers cutting-off blades and holders under license issued by John Milton Luers Patents, Inc. These blades and holders are so designed that, when assembled, they have the rigidity of a solid forged tool.

Weltronic Corporation, Detroit, Mich., manufacturer of resistance welding controllers and general purpose timers, is moving into a new plant on East Outer Drive, Detroit. The building has approximately 8700 square feet of manufacturing space, with provisions for adding facilities as needed.

Service Tool & Machine Parts, Inc., 8111 Livernois Ave., Detroit, Mich., has been formed to engage in making tools and machine parts. John Verlinden, formerly with the East Side Gear & Tool Co., Detroit, is president of the corporation.

New England

Flame Treating and Engineering Co. has opened a plant at 181 Homestead Ave., Hartford, Conn., for the hardening, softening, and strengthening of machine parts by the oxy-acetylene flame. The concern operates under license by The Linde Air Products Co. The president of the company is L. T. Benoit, formerly district engineer with The Linde Air Products Co.

Clinton D. St. Clair has been appointed works manager of the Hancock Valve Division plant of Manning, Maxwell & Moore, Inc., Boston, Mass. Mr. St. Clair has had twenty-two years of manufacturing experience with several well-known companies.

Taft-Peirce Mfg. Co., Woonsocket, R. I., manufacturer of machinery and tools, announces the election of Walter E. Rogers as assistant secretary of the company. Mr. Rogers has been with the company since 1921, except for a period of less than four years. Since 1927, he has been, first, Indianapolis representative, and subsequently in charge of all Western sales offices.

Jessop Steel Co., Washington, Pa., has appointed H. A. Scallen district manager for the Hartford branch of the company, 626 Capitol Ave., Hartford, Conn. Mr. Scallen has been a representative in the New England territory since 1930. H. F. Robertson has been appointed sales representative with the Hartford branch.

H. A. Scallen, New District Manager in Hartford, Conn. for Jessop Steel Co.

H. F. Robertson, Sales Representative, Hartford Branch of Jessop Steel Co.

New York

Carl A. W. Brandt, chief engineer of the Superheater Co., New York City, received the Melville Medal for original engineering work at the annual meeting of the American Society of Mechanical Engineers, held in New York City early in December. Mr. Brandt was born in Sweden in 1881 and received his early mechanical engineering training and experience in that country. After coming to this country, he obtained a position in 1902 with the New York Central Lines, where he became mechanical engineer and master mechanic of the Big Four System. He joined the Superheater Co. as chief engineer in 1916.

Oakite Products, Inc., 22 Thames St., New York City, recently held a sales conference in New York at which emphasis was laid on the response of the metal-working, machine tool, transportation, and other industries to the call for greater production to meet national defense requirements. Among those who addressed the meeting were C. B. Peck, managing editor of *Railway Mechanical Engineer;* Lieutenant Colonel L. A. Codd, managing editor of *Army Ordnance;* and Erik Oberg, editor of Machinery.

American Brake Shoe & Foundry Co., 230 Park Ave., New York City, announces that the business of the Kellogg Compressor & Mfg. Corporation, which was taken over by the former company in 1939, will be continued in the future under the name of the Kellogg Division of American Brake Shoe & Foundry Co. The products, which include air compressors and service station equipment, will be known as "Kellogg-American" products. The Kellogg organization has been retained, with J. F. Weller as president.

Alberto Ubbelohde, Inc., 2 Rector St., New York City, has been organized by Alberto Ubbelohde & Cia of Buenos Aires, Argentina, for the purpose of exporting metallurgical products of all kinds, as well as importing products from Argentina and Uruguay. The officers of the newly organized company are Alberto Y. Ubbelohde, president; Jules Dierckx, vice-president; and T. Y. Lancaster, secretary and treasurer.

General Electric Co., Schenectady, N. Y., announces that plans for the expenditure of about $400,000 are being made for the expansion of the eastern facilities of the plastics department of the company. The expansion will include new buildings and equipment in Pittsfield, Mass., and Meriden, Conn., and additional equipment in the Lynn, Mass., plant.

R. E. Zimmerman, vice-president of the United States Steel Corporation, has been elected president of the American Standards Association.

J. Hal Marshall has been appointed sales representative in the Buffalo district by the Jessop Steel Co., Washington, Pa., with headquarters at 130 Groveland Ave., Buffalo, N. Y. Mr. Marshall was formerly employed in the company's general office in Washington.

Sterling Electric Motors, Inc., Los Angeles, Calif., has established an office at 11 W. 42nd St., New York City, with Allen A. Adams in charge as eastern manager.

Ohio

Paul L. Gillan has recently joined the automotive and industrial engineering consultation staff of Aluminum Industries, Inc., Cincinnati, Ohio. In this capacity, he will work with the engineering staffs of automotive, aircraft, and industrial companies on parts and castings problems. He was formerly assistant chief engineer with the Lycoming Mfg. Co., of Williamsport, Pa.

Timken Roller Bearing Co., Canton, Ohio, announces that a $3,000,000 expansion program is under way in the four plants of the company at Canton, Gambrinus, Columbus, and Mount Vernon, Ohio, to meet national defense requirements. Electric furnace equipment orders amounting to over $550,000, and orders for nearly $1,000,000 worth of machine tools have recently been placed, and additional orders are pending.

Aluminum Industries, Inc., Cincinnati, Ohio, manufacturer of Permite automotive and aircraft parts, aluminum and magnesium alloy castings, and aluminum paints, have started the construction of a new plant unit containing 150,000 square feet of floor space to be ready for operation April 1. Construction of other units, to follow later, are also planned.

Lempco Products, Inc., Bedford, Ohio, manufacturers of automotive service equipment and machinery, as well as replacement parts, have let contracts to greatly expand their present plant. The plans call for an increase of about 50 per cent over the company's present production program.

Foote-Burt Co., Cleveland, Ohio, announces that the company has purchased the Hammond Mfg. Co. of the same city. The surface grinding machines and radial drilling machines produced by the latter company will continue to be manufactured at the Hammond plant and will retain that name.

Sheffield Gage Corporation, Dayton, Ohio, is erecting a 32,000 square foot air-conditioned gage-manufacturing plant in connection with the National Defense Program. The plant slightly more than doubles the company's present capacity.

Pennsylvania

A. M. Byers Co., Pittsburgh, Pa., manufacturer of wrought iron, announces that the company will enlarge its activities to include the production of a broad line of alloy steels, including stainless steel. Actual production will be started in from four to six months. An addition will be built to the company's Ambridge plant, in which new electric furnace equipment will be installed.

Elmer Ghrist has been appointed metallurgist for the Jessop Steel Co., Washington, Pa. He is a graduate of

Elmer Ghrist, Metallurgist for the Jessop Steel Company Washington, Pa.

the Washington and Jefferson College, 1932, and has been employed by the Jessop Steel Co. since 1935.

McKenna Metals Co., Latrobe, Pa., because of the greatly increased demand for carbide tools, has found it necessary to double its production capacity within the last few months. Three new buildings have been erected and a considerable amount of new equipment has been installed.

George R. Sylvester, formerly chief engineer of the Allied Engineering Co., has joined the staff of the Ajax Electric Co., Inc., Philadelphia, Pa., in the capacity of technical advisor.

Texas

A. R. Engler will be in charge of a new southwestern district office, located in the West Bldg., Houston, Tex., from which he will handle the sales and service of Kearney & Trecker milling machines and Gisholt turret lathes, automatic lathes, and balancing machines. He will be assisted by Starr Pitzer and Ray Dorow.

Washington, D. C.

MARITIME SERVICE BUREAU, Bond Bldg., Washington, D. C., has been organized for the purpose of attending to applications of exporters and manufacturers seeking export licenses from the State Department. MICHAEL H. KUZYK is manager of the bureau.

Wisconsin

GISHOLT MACHINE CO., Madison, Wis., at a recent meeting of the board of directors, elected A. B. MOREY vice-president and H. J. HOMEWOOD treasurer. Mr. Morey has served as treasurer for the last four years, and Mr. Homewood has been chief accountant and office manager for the last ten years. C. K. SWAFFORD, who has been general superintendent since 1930, was elected a member of the board of directors. He will continue to fill his duties as superintendent.

AMPCO METAL, INC., 1745 S. 38th St., Milwaukee, Wis., has completed a new office building, made necessary by the demands of the production departments for increased space. The former office space will be equipped with new machine tools for finishing Ampco metal castings. The new two-story, 45- by 100-foot office building is constructed with glass-block walls and equipped with fluorescent lighting and air-conditioning. Ground has been broken also for two additions to the foundry.

W. C. BUCHANAN, president of the Globe Steel Tubes Co., Milwaukee, Wis., was elected a member of the board of directors of the Allis-Chalmers Mfg. Co., of Milwaukee, at a recent meeting of the board. Mr. Buchanan was named to fill one of two vacancies on the Allis-Chalmers board created by the deaths of General Otto H. Falk, former board chairman, and of Oscar Gubelman, a director for many years.

* * *

All that has contributed to our progress has come from the sound reasoning of a human mind or the inspiration of a human soul. Government never invented anything save, perhaps, the means of enlarging its own power, transforming its citizens into automatons, or discovering new methods of employing political authority to meet the insistent demands of powerful minorities. By whatever terms you describe it, the outstanding issue today is between private enterprise, personal initiative, and individual stimulation to progress on the one hand, and the steady encroachment of political mastery over freedom of action and agreement on the other.—*Howard Coonley, Past-President of the National Association of Manufacturers.*

OBITUARIES

J. Wallace Carrel

J. Wallace Carrel, vice-president and general manager of the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, died on December 16. He had been in poor health for some time.

Mr. Carrel was born February 16, 1867. He had a very long and successful career in the machine tool industry, in which he was engaged for almost fifty-two years. It was on December 28, 1888, that he entered the employ of the Lodge & Davis Co. of Cincinnati. Nearly four years later, in 1892, the Lodge & Davis Co. changed its corporate name to Davis & Egan. Mr. Carrel continued with this organization until 1897, when he left the concern and went with Charles E. Billen Co., of Chicago, Ill. A year later he left this company to go with Hill, Clarke & Co., Boston, Mass., with which concern he remained for a number of years.

In 1908, he made an extensive tour of the industrial centers of Europe for the *American Machinist*. On the basis of the information thus obtained, he prepared the most comprehensive report on the application of American machine tools in European industries that had been made up to that time. Upon his return to the United States, he became, on February 1, 1909, general sales manager of the Lodge & Shipley Machine Tool Co., with which concern he remained for the rest of his life—a period of nearly thirty-two years. In 1917, he became vice-president and general manager of the company, which position he held until the time of his death.

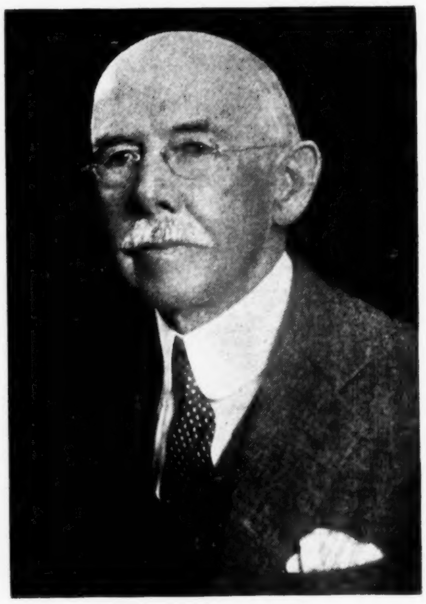
Mr. Carrel was widely known throughout the machine tool industry, and among the customers of that industry. His sterling qualities won him a great many friends, who will greatly regret to learn that he has passed away.

J. Wallace Carrel

Alvin Irwin Findley

Alvin Irwin Findley, who was editor of *The Iron Age* for twenty years prior to his retirement in 1930, and who spent, in all, fifty years in the publishing field, first in newspaper work and later in business journalism, died on December 12 at St. Petersburg, Fla.

Mr. Findley was born in Monmouth, Ill., in 1859. From 1892 to 1905 he was editor of the *Iron Trade Review*, now known as *Steel*. In 1905, he became associate editor of *The Iron Age*, advancing to editor-in-chief in 1911, a position that he held until 1930, when he retired.



Alvin Irwin Findley

Mr. Findley was one of the outstanding men in business journalism, and was the first president of the National Conference of Business Paper Editors, organized in 1919. He was a director of the United Publishers Corporation, now the Chilton Co., from 1924 to 1932. He was also a member of the American Iron and Steel Institute, the Iron and Steel Institute of Great Britain, the American Institute of Mining and Metallurgical Engineers, the American Foundrymen's Association, the American Society for Testing Materials, and many other societies and associations.

BRUCE W. DEACON, for the last eleven years Detroit manager for the D. A. Stuart Oil Co., died December 9 at the Ford Hospital, Detroit, after an illness of several weeks. He was fifty-seven years old. After having served his apprenticeship, he became a toolmaker and continued in this work until he

entered the lubricating oil business in 1919. He was one of the best known industrial oil salesmen in Detroit, and enjoyed the acquaintance, confidence, and friendship of hundreds of Detroit factory and purchasing officials.

COMING EVENTS

JANUARY 6-10—Annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at Book-Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

MARCH 24-29 — MACHINE AND TOOL PROGRESS EXHIBITION at Convention Hall, Detroit, Mich., under the auspices of the American Society of Tool Engineers, 2567 W. Grand Blvd., Detroit, Mich.

MARCH 25-29 — MACHINE AND TOOL PROGRESS EXHIBITION, under the sponsorship of the American Society of Tool Engineers, to be held in Convention Hall, Detroit, Mich. For further information, address Ford R. Lamb, executive secretary, 2567 W. Grand Blvd., Detroit, Mich.

APRIL 1-3—Spring meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at Atlanta, Ga. C. E. Davies, secretary, 29 W. 39th St., New York.

MAY 5-7—Twenty-fifth annual convention of the AMERICAN GEAR MANUFACTURERS ASSOCIATION at the Homestead, Hot Springs, Va. J. C. McQuiston, secretary, 602 Shields Bldg., Wilkinsburg, Pa.

MAY 12-15—Annual convention of the AMERICAN FOUNDRYMEN'S ASSOCIATION at the Hotel Pennsylvania, New York City. C. E. Hoyt, executive secretary, 222 W. Adams St., Chicago, Ill.

MAY 19-23—WESTERN METAL CONGRESS AND EXPOSITION to be held in Los Angeles, Calif., under the auspices of the American Society for Metals. The Congress will have headquarters at the Biltmore Hotel, and the Exposition will be held in the Pan American Auditorium. W. H. Eisenman, secretary, 7301 Euclid Ave., Cleveland, Ohio.

JUNE 16-20—Semi-annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at Kansas City, Mo. C. E. Davies, secretary, 29 W. 39th St., New York City.

OCTOBER 12-15—Fall meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at Louisville, Ky. C. E. Davies, secretary, 29 W. 39th St., New York City.

NEW BOOKS AND PUBLICATIONS

ARC-WELDING INSTRUCTION COURSE (Two Volumes). Volume 1: Lectures, 89 pages, 8 1/2 by 11 inches. Volume 2: Exercises, 101 pages, 8 1/2 by 11 inches. Published by Air Reduction, 60 E. 42nd St., New York City. Price of each volume, $1.

These volumes have been prepared for the guidance of instructors, as well as for the conscientious student who wishes to acquire a reasonable degree of efficiency in arc welding. It is recognized that the best a course of instruction can do is to provide a fundamental knowledge on which the student must build by diligent application and practice. Too much stress cannot be laid on the necessity for continued practice as the only means of developing skill.

The lectures in this course are provided for the guidance of the instructor in giving his classroom instruction in theory. The exercises start with the basic operation of striking and holding an arc with the bare electrode, gradually leading up to more difficult operations requiring judgment and skill. The publishers state that it is not expected that this course will turn out finished operators. However, if the student will apply himself to the study of the lectures and to the work exercises and practice faithfully, he will find that at the completion of the course, he has a good basis on which to work further toward mastery of the art.

MATERIALS HANDBOOK. By George S. Brady. 591 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York City. Price, $5.

This is the fourth edition of an encyclopedia for purchasing agents, engineers, executives, and foremen, covering all classes of industrial materials. Brief summaries of the various materials are given, including their outstanding characteristics and applications, as well as other basic data. The book has been brought up to date by continuous contact with the producers of materials and analysis of the current published researches of technical experts in the various industries. It is not intended to be an exhaustive treatise on any material, but merely to provide general information and such figures as will enable the purchasing executive or product engineer to form a quick comparative judgment of material characteristics.

KINEMATICS OF MACHINES. By George L. Guillet. 300 pages, 5 3/4 by 8 1/2 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $3.

This is the fourth edition of a book written to provide in concise form the necessary material for an elementary course on the kinematics of machines suitable for sophomores and junior students of engineering. Some changes have been made to accord with present practice, and there has been a considerable addition to the number of problems. The material is divided into eleven chapters dealing with the following subjects: General Considerations; Displacement, Velocity, and Acceleration; Instant Centers; Velocity and Acceleration in Plane Motion; Slider-Crank Mechanisms; Cam Mechanisms; Rolling Contact; Toothed Gearing; Gear Trains; Flexible Connectors; and Miscellaneous Mechanisms. Each chapter is followed by a list of questions to test the student's knowledge.

WELDING METALLURGY. By O. H. Henry and G. E. Claussen. 359 pages, 5 1/2 by 8 inches. Published by the American Welding Society, 33 W. 39th St., New York City. Price, $1.50.

Recognizing the need for information on the fundamentals of metallurgy as applied in the welding field, the New York Section of the American Welding Society has sponsored a series of lectures to familiarize the members in the welding industry with the composition and structure of the metals commonly welded, to show the effect of varied conditions of heat and stress in welding, to explain heat-treatments, and to illustrate how the knowledge of metallurgy can be used to control welding processes. The book is composed of eighteen lectures giving thorough information on the subject; it is illustrated with numerous micrographs and diagrams. Unfortunately, the book is not indexed; a complete index would have greatly enhanced its value.

SABOTAGE—HOW TO GUARD AGAINST IT. By Harry Desmond Farren. 56 pages, 5 1/2 by 8 inches. Published by National Foremen's Institute, Inc., Deep River, Conn. Price, $1.

The purpose of this book is to inform the employers and workers in American industry of the serious dangers that may confront them through the insidious work of foreign-paid agents and misguided men and women who are bent upon the destruction of our nation and its industries. While the book contains some specific directions on how to prevent sabotage and how to act in cases where sabotage has been committed, the major part is devoted to pointing out the real danger that exists through the presence of men and women who are employed by foreign governments to

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hamper American industry. Their acts may cause serious damage to industrial buildings and equipment, and frequently severe injury to the men and women employed in industry.

Sales Engineering. By Bernard Lester. 200 pages, 5 1/2 by 8 1/2 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $2.

The purpose of this book is to place before the younger sales engineer in simple terms the principles of sales engineering, and to suggest the opportunities for him in present-day society. The book should prove of value also to the experienced sales engineer who desires to advance and improve his present sales methods, as well as to many highly technical engineers whose usefulness can be broadened by a better knowledge of sales principles and practice. The three principal sections of the book cover the field of sales engineering; the work of the sales engineer in selling; and the training of the sales engineer.

Steel Castings Handbook. 503 pages, 6 by 9 inches. Published by the Steel Founders' Society of America, 920 Midland Bldg., Cleveland, Ohio. Price, $2.

This book has been prepared to serve as a reference for all who are concerned with producing or using steel castings. It has been in preparation for several years, and is believed to be the most complete treatise of its kind ever compiled. The text covers the manufacture of steel castings; heat-treatment; mechanical properties of various types of steel, both carbon and alloy; engineering properties of cast steel; steel casting design; pattern equipment; and industrial uses of steel castings.

Advanced Machine Work. By Robert H. Smith. 835 pages, 5 by 8 inches; 932 illustrations. Published by the Industrial Education Book Co., Box 153, Back Bay, Boston, Mass. Price, $3.25.

This is the twelfth revised edition of a textbook on advanced machine work prepared for students in technical, manual training, and trade schools and for the apprentice and machinist in the shop. The text is divided into fourteen sections covering lathe work; drilling jigs, boring-bars, and eccentric turning; cylindrical grinding and internal grinding; surface grinding and cutter grinding; planing; milling; gear-cutting; toolmaking; inspection and limit system of manufacturing.

Engineering Defense Training. Compiled by Harrison W. Craver and Harrison A. Von Urff. 13 pages, 6 1/2 by 9 1/2 inches. Published by the American Library Association, 520 N. Michigan Ave., Chicago, Ill. Single copies, 25 cents; quantities at reduced rates.

This booklet contains a list of standard works, including periodicals, on aeronautical engineering, industrial management, machine shop practice, naval architecture, and marine engineering. It has been compiled especially for the use of engineers preparing for work in connection with National Defense.

* * *

According to the International Nickel Co. of Canada, Ltd., more nickel was consumed in 1940 than in any previous year in the life of the industry. This included both war demands and peacetime requirements.

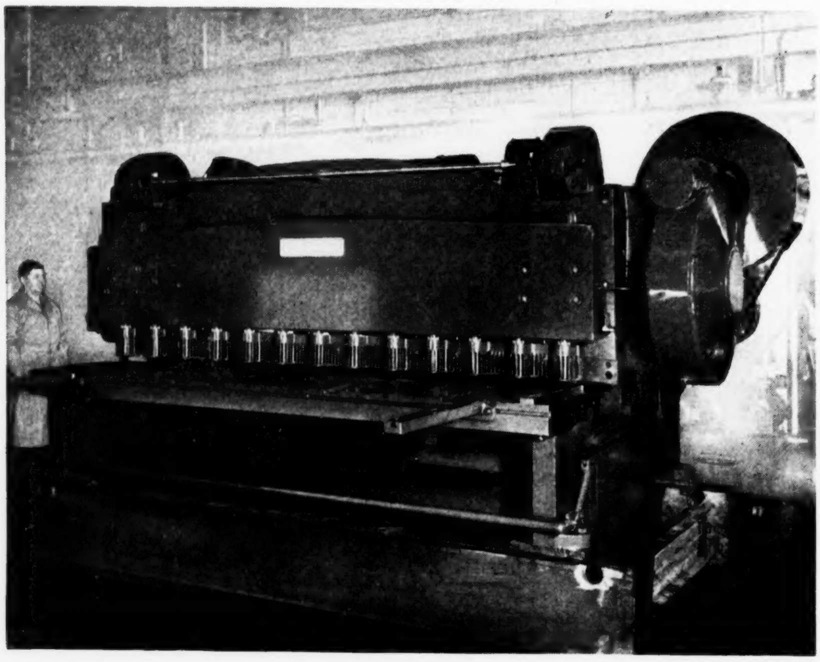
Elements of Machine Shop Practice

An unusual idea of presenting the elements of machine shop practice is embodied in a calendar originated by Leighton Wilkie, president of Continental Machines, Inc., Minneapolis, Minn. The object is to interest young men in machine shop training, so that they may be fitted for the jobs that must be filled in meeting the present Armament Program.

The theme of the calendar is "Twelve Easy Lessons in the Fundamentals of Machine Shop Practice." To give the information longer life, it is presented in calendar form, so that it can be posted in shops, technical schools, and in places where metal workers, students, or unemployed men congregate. The lessons are presented in twelve posters, each lesson being displayed for one month. The following month a new step is presented, so that at the end of the year, a conception of the principles embodied in metal cutting with machine tools will have been obtained.

The need for some means of stimulating interest in machine shop work is obvious. Statistics indicate that there are a dozen young men being educated for every existing professional job, while, for every seven mechanics at work, only one apprentice is being trained. The chief object of the calendar, therefore, is to stimulate interest through giving the young man a conception of what machine tools are and what work they perform.

While the supply of these calendars lasts, copies will be sent free by Continental Machines, Inc., Minneapolis, Minn., to any firm who has a good place to exhibit it, so that it gets the attention of the employes.



An All-steel Plate Shear Recently Built by the Cincinnati Shaper Co. for the U. S. Navy Yard, Norfolk, Va. This Machine Has a Capacity for Shearing 1-inch Mild Steel 12 Feet Long. It is of Rolled-steel Plate Construction, 12 Feet 3 Inches between Housings, and is Equipped with a Fluorescent Light Beam Shearing Gage, Hydraulic Hold-downs, and Micrometer Ball-bearing Back Gage. Its Net Weight is 88,000 Pounds